DOCUMENT RESUME

ED 114 276 SE 019 716

AUTHOR	Richardson, Ralph W., Jr., Ed.; Nash, Roderick, Ed.
TITLE	Four Universities: Achieving Environmental Quality through Environmental Education and Research.
INSTITUTION	Rockefeller Foundation, New York, N.Y.
PUB DATE	May 75
NOTE	68p.
AVAILABLE FROM	The Rockefeller Foundation, 111 W. 50th St., New York, New York 10020 (no price quoted)
EDRS PRICE	MF-$0.76 HC-$3.32 Plus Postage
DESCRIPTORS	*Educational Programs; *Environmental Education; Financial Support; Foundation Programs; *Higher Education; *Instructional Programs; *Research; Surveys; Universities
IDENTIFIERS	*Rockefeller Foundation

ABSTRACT

Five universities receiving aid from the Rockefeller Foundation are discussed. The American University has had difficulty initially interdisciplinary environmental studies. Problems include insufficient financial independence, autonomous faculty nature, seniority system. students, and departmental structure. Penn State's efforts involve development of the Office of Environmental Quality Programs, which recognizes environmental issues, determines goals, and assimilates people and resources to accomplish tasks. The University of Michigan's Institute for Environmental Quality focuses resources on problems associated with improving the quality of the environment through support of multidisciplinary teaching, research, and service activities. Utah State's Environment and Man Program provides faculty, staff, and students with interdisciplinary research and educational opportunities to study environmental problems in Utah and the Rocky Mountain Region. Environmental studies at the University of California, Davis, center on ecology and involve undergraduate and graduate instruction, research, and public service. Recommendations for initiating environmental education and research include continuity of tenured faculty, interdisciplinary program concerns, administrative support, and campus-wide environmental study units. (BP)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED114276

U S DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

FOUR UNIVERSITIES

Achieving Environmental Quality through Environmental Education and Research

A Special Report from The Rockefeller Foundation

Edited by
Ralph W. Richardson, Jr.
Roderick Nash

SE 019 716

Cover: Robert S. Beese Beese Photo Service State College, Pennsylvania

TABLE OF CONTENTS

INTRODUCTION Dr. Ralph W. Richardson, Jr. 3

1 THE ROCKEFELLER FOUNDATION AND HIGHER EDUCATION: AN HISTORICAL OVERVIEW Mr. Chadbourne Gilpatric 5

2 ENVIRONMENTAL STUDIES AND THE AMERICAN UNIVERSITY Dr. Roderick Nash 9

3 THE OFFICE OF ENVIRONMENTAL QUALITY PROGRAMS AT THE PENNSYLVANIA STATE UNIVERSITY Dr. Richard D. Schein 15

4 THE INSTITUTE FOR ENVIRONMENTAL QUALITY AT THE UNIVERSITY OF MICHIGAN Dr. A. Geoffrey Norman 25

5 THE ENVIRONMENT AND MAN PROGRAM AT THE UTAH STATE UNIVERSITY Dr. Cyrus M. McKell 31

6 THE DIVISION OF ENVIRONMENTAL STUDIES AT THE UNIVERSITY OF CALIFORNIA, DAVIS Dean Robert A. Matthews and Dr. Leonard O. Myrup 41

7 FIFTEEN RECOMMENDATIONS FOR DEVELOPING ENVIRONMENTAL EDUCATION AND RESEARCH AT AMERICAN UNIVERSITIES Dr. Roderick Nash 49

8 TOWARD PARADIGMS FOR ENVIRONMENTAL RESEARCH IN UNIVERSITIES Dr. Raymond J. Nelson 57

A SELECTED BIBLIOGRAPHY OF HIGHER ENVIRONMENTAL EDUCATION 67

A two-day conference held in the Rockefeller Foundation's New York office brought together program leaders and graduate students from the four universities for discussion with Foundation staff and consultants.

INTRODUCTION

Dr. Ralph W. Richardson, Jr.
Director, Natural and Environmental Sciences
The Rockefeller Foundation

WHY CHOOSE UNIVERSITIES?

The Rockefeller Foundation's Quality of the Environment Program has as its major aim the improvement of man's ability to address and solve important environmental problems. One criterion for success in this endeavor is the development of permanent institutional capability to discern and discuss and research such problems. Universities are the obvious candidates for this role. Few would question that collectively they constitute the nation's leading bank of intellectual talent and research capability. And in their teaching function at the undergraduate, graduate and community service (extension) levels, universities can exert a major influence on public opinion.

A special advantage of the university's abilities in this regard is its continuing nature. Universities can integrate environmental teaching and research, making these activities a part of the regular program over many years. This kind of sustained effort is particularly important when dealing with subjects of great complexity such as the man-environment interface. From a granting organization's point of view an investment in a university is much more likely to produce multiplied, long-term dividends than would be a comparable award to a "think tank." In the case of the latter the interest in the problem usually ends with the grant. In contrast, to start a university in a new direction is to open a broad range of future possibilities.

The Four Universities

The Rockefeller Foundation's program in support of research and teaching in environmental studies in selected universities began, after extended planning and negotiation, on January 1, 1970 with a grant of $750,000 to the University of Michigan. On April 1 of the same year an award of $284,000 was made to the University of California's Davis campus, and on June 1, 1972 the university received an additional $490,000. Support of both Utah State University and Pennsylvania State University began on January 1, 1971, with grants of $600,000 and $750,000 respectively.

Evaluation of these grants has been remarkable for its intensity and thoroughness. Between May and November 1973 a team of Foundation staff conducted three-day, on-site reviews at each of the four universities. In the interest of securing different perspectives, Dr. Roderick Nash, Professor of History and Environmental Studies at the University of California, Santa Barbara, and Dr. Raymond J. Nelson, who is the Truman P. Handy Professor of Philosophy at Case Western Reserve University, joined the review team. Extensive analytical reports followed each visitation. On March 20 and 21, 1974 representatives of each university, including administrators, faculty and graduate students, joined with Foundation staff and consultants in New York for a Conference on Education and Research in Environmental Affairs for American Universities. The present publication summarizes the achievements of the universities and reports on the evaluative follow-up.

GRANT OBJECTIVES

While stimulation of higher education at the four universities was the immediate objective of the grant program, its broader purpose was to see what impact sizable outside financial aid to environmental teaching and research would have on the long-term directions of each institution. Still broader was the implicit hope of interesting higher education generally in environmental problem solving. And finally the Rockefeller Foundation sought to experiment with the kind of interdisciplinary, inter-institutional, and international approach that seems mandatory in this enormously complex field.

The Story: Successes . . .

The accomplishments of the four universities are evident in the pages that follow. Suffice it to say at

this point that hundreds of talented individuals, both at the beginning and in the prime of their academic careers, have been favorably affected. The grants have stimulated interdisciplinary research on important regional problems. Teachers and scholars who otherwise might not have ventured into interdisciplinary, problem-oriented work have been assisted. In most respects the energies, ideals, and the institutional arrangements the grants released on the four campuses are ongoing. Indeed it is clear that one of the overriding benefits of the grants was the creation of a mood or climate of opinion at these universities that favored environmental study. Intangible and subtle as such attitudes certainly are, they nonetheless exert a powerful influence on the direction that higher education takes. The Foundation is proud to have helped give environmental studies greater visibility and greater attention in the several academic communities.

. . . and Disappointments

Assuredly, there have also been disappointments. But we feel we have learned as much from unexpected failures as from planned achievements. Initially the Foundation believed that the four recipients of the grants would create models or patterns that other institutions would follow in advancing higher environmental education. In fact, part of the rationale behind the geographic distribution of the grants (East, Midwest, Rocky Mountains, Far West) was to provide regional centers of excellence that other institutions might emulate. What we found, instead, was that each academic environment is unique and, in a sense, nonreplicable. The points of leverage that move institutions vary and so do their modes of organization and operation. Faculty interests are, of course, diverse. It follows that pragmatism is the appropriate philosophy in encouraging academic change. If a particular course of action works to advance environmental studies at a particular university, it should be accepted and applauded regardless of its degree of conformity to a preconceived pattern.

A NEW KIND OF GRANT PROGRAM

The failure of a nationwide pattern of higher environmental education to emerge underscored the wisdom of an early Foundation decision regarding flexibility. Few conditions were attached to the grants in question. The four universities were given free rein to advance the study of environmental problems in ways that they felt would be most productive. These flexible funds provided the opportunity to experiment with organizational and administrative change in the advance of education and regional research. This policy broke quite radically with Rockefeller Foundation tradition, but it appeared to be the best assurance for the continuation of environmental emphasis at a university after the expiration of the grant. To have imposed an unwelcome organizational formula would have invited its rapid dismissal after Foundation interest ceased.

Can It Work?

The expectation that a few institutions could be bellweathers for their region also proved illusory. The four institutions in question had a hard enough time launching their own interdisciplinary environmental programs without the added burdens of neighborhood leadership. University collaboration with government agencies is also a difficult but essential activity, and requires further intensified effort. However, the universities have devised effective strategies for new and broader interdisciplinary approaches to problem solving. They have directly assisted, through cooperation with government agencies, in the resolution of critical land use and water management problems. To a remarkable degree, the laboratories and classrooms have been taken to the fields, urban areas, and countrysides where the issues and problems exist.

Distinctive patterns of organization and administration emerged at each university. Numerous discussions with staff and students, and extended observations of research and teaching activities, have lead to a number of generalizations about how and how not to define and disseminate environmental studies in a university context.

A distillation of the Foundation's experience is presented in Chapter 7. It will be obvious that these recommendations represent ideals rather than a record of what has actually been done at the four universities. Also clear is the need to apply the recommendations pragmatically to the specific institutional context. They emerge as factors observed among the four universities which have directly and effectively assured productivity and excellence in their environmental programs. The recommendations, along with the experience of the four universities, suggest that it is possible for every institution of higher education to become more responsive to man's vital need to solve his environmental problems.

1

THE ROCKEFELLER FOUNDATION and HIGHER EDUCATION: An Historical Overview

Mr. Chadbourne Gilpatric
Deputy Director, Hudson Basin Project
The Rockefeller Foundation

Activities of The Rockefeller Foundation in higher education are a larger subject than one might expect.* They extended through more than six decades since the Foundation began its work in 1913. Over the years, the Foundation has contributed to higher education in all the states of the United States and in most foreign countries. In the quarter century between World Wars I and II, the Rockefeller Foundation was the only philanthropic agency of its kind with a broad international charter, "to promote the well-being of mankind throughout the world," and able to apply substantial resources to fund innovations in research and teaching. The charter has continued unchanged, but happily since World War II other foundations have been active in the international scene, and both governmental and international programs have been developed on a massive scale.

Besides appropriations to many hundreds of institutions of higher learning at home and abroad, the Foundation provided 'project' grants to thousands of scientists and scholars. From 1915 through the present it has also maintained a fellowship and scholarship program—with awards exceeding ten thousand—primarily benefiting academic careers. Of well over one billion dollars given out by the Foundation, at least three-quarters served higher education in one form or another.

With few exceptions the Foundation's supporting activities in education were focused at higher levels —college and post-graduate teaching, research, and the essential tools of knowledge, libraries, scientific equipment, and laboratories. Primary and secondary education were considered a public rather than private concern, with the large scale of their necessary support coming from public sources.

THE FOUNDING OF UNIVERSITIES

At its inception the Foundation was predisposed to assist higher education. During the years before the Foundation was actually launched, this area had attracted the support of John D. Rockefeller, Sr., the Foundation's creator, and the active attention of his advisers, notably Frederick T. Gates. Thanks to Gates' vision and Rockefeller's benefaction (in the order of 31 million dollars), the University of Chicago was founded and developed before the turn of the century. This university emerged as a far more ambitious and complex institution than the denomi-

* *A sampling of indices in the Foundation's annual reports would find little mention of higher education per se, but rather the names of many universities, colleges, institutes, and centers.*

national Baptist college its initial proponents had envisaged. The Rockefeller Institute for medical research (later renamed Rockefeller University) was established in 1901. With positions and facilities endowed to achieve excellence in medicine, the Institute probably exerted the single most important influence on the standards of research and performance in this field in the early twentieth century.

Again at the advice of Gates, Rockefeller set up the General Education Board in 1907. During its fifty years (until its principal funds had been expended), this Board concentrated on educational needs of the southern United States, largely through the development of colleges and universities.

THE ROCKEFELLER FOUNDATION GOES TO CHINA

When The Rockefeller Foundation came into existence just before the first World War (1913), China was attracting the attention of many Americans. Here was the spectacle of an ancient civilization confused by the recent collapse of its traditional imperial government and suffering widespread poverty and difficulties of economic underdevelopment. It was the only Asian country other than the Philippines that was open to American intervention. (Japan had a strong government, and European nations controlled other large areas like India, Indochina, and Indonesia.) American intervention, however, was mostly pacific and took the form of missionary activity. In the gestation years of the Foundation, Gates had advocated the creation of a great new university in China, perhaps along the lines of the University of Chicago. This proposal was explored and found quite impracticable by the Burton Commission to China, a Rockefeller-financed survey in 1913 of that country's conditions and needs.

Peking Union Medical College

Concern with China and with the tested importance of public health and medical research were dominant in the thinking of the Foundation's first trustees. One of their initial actions was to convene a conference on China and its needs to which the Foundation might address itself. In this meeting—eight months after the doors of the Foundation were opened—the powerful persuasion of former President Charles Eliot of Harvard prevailed, and the Foundation committed itself to the creation of a college in China for medical research and training. This was the Peking Union Medical College, formally inaugurated in 1921, and solely supported by The Rockefeller Foundation (and its component, later incorporated as a separate organization, the China Medical Board). Although located as far away as Peking, this college was so well staffed and its research was of such high quality that it soon became a key training ground for faculties of some of the leading major medical schools in this country, notably Harvard, Johns Hopkins, and Michigan. (A detailed history of the Peking Union Medical College, *Western Medicine in a Chinese Palace*, by Dr. John Z. Bowers, was published about a year ago.)

In accord with its mandate "throughout the world," the Foundation rapidly extended its interests to many other countries. Well short of its first decade it was active in Europe, Asia, Africa, and Latin America, as well as in North America, supporting institutions of higher learning, developing individual talent and leadership through fellowships, and promoting research.

THE THREE "R's" OF HIGHER EDUCATION

Three principles which have continued to be central in the policies and programs of The Rockefeller Foundation were applied in its early support of the Peking Union Medical College (and of other similar institutions since then). One was to *encourage and strengthen both teaching and research and their reciprocal linkages*. It is widely recognized that advanced levels of teaching, e.g. Ph.D. programs, became hard to distinguish from research. Research, on the other hand, while sometimes seeking a life of its own, in fact gains input, value, confirmation, and above all continuation through teaching and the students taught. In most colleges and universities these two basic functions tend to be separated, and even to compete. An undiminished Foundation effort has been to keep research and teaching in balance, and to reinforce either one where it lags badly behind the other.

A second principle, as is well known, was *international: advancement of higher education* abroad as well as in the United States. The extent of Foundation activity in foreign countries has inevitably changed over time, adjusting to needs, opportunities, and its own program priorities. During the three decades that ended in the mid-1950's, for example, major attention and support was given to European institutions. In the mid-1950's there was a strong redirection of Foundation work to the developing areas of Asia, sub-Saharan Africa, East and Southern Asia, and Latin America. In these large areas

specific countries were selected for major attention, largely by criteria combining needs and opportunities, and in line with defined Foundation program objectives. The dominant concern abroad with developing countries, which continues up to the present, required the curtailment (often difficult) of earlier support in Europe and Japan.

A third principle was to *promote research and other higher educational functions related to underlying problems of human well-being.* (Proponents of land grant universities sometimes sound as if they invented this commitment, and alone put it into practice.) In the case of the Peking Union Medical College, research as well as the training of doctors and nurses was related to the improved health of the Chinese people, and beneficiaries elsewhere.

THE FOUNDATION'S RECORD

The record of the Foundation's programs in higher education over six decades is in part a history of what the Foundation conceived to be the broad problem areas that most needed academic attention, and how these areas evolved over time.

In its first fifteen years (1913-28) Foundation efforts and funding were largely devoted to medical research and public health. During the subsequent twenty-five years a number of other areas attracted Foundation attention and support, notably medical education, the natural sciences, the social sciences, and the humanities. These areas as stated actually became the titles of the Foundation's program divisions from the start of the 1930's to the mid-1950's, and some have persisted to the present. Each of these program divisions ranged broadly in subject and place, and pursued the Foundation principles summarized above: balance in teaching and research, advancement of knowledge at home and abroad, and higher education responsive to human needs.

A Search for Targets

Attentive to changing conditions, needs, and opportunities, as well as to its own limitations, the Foundation tried to find specific targets and means of concentration within widely defined fields of interest, for example, health and agriculture. Such concentrations represent strategies of major efforts and funding over relatively long periods of time (five or ten years or even longer). To illustrate, in the early 1930's support for medical education included a high and influential priority for psychiatry. Also in the thirties, in the natural sciences, the Foundation launched an imaginative and productive strategy to develop experimental biology, including an intensive build-up of biochemistry. Thanks to the new capabilities for plant and animal genetic manipulation which grew out of this program strategy, the Foundation later conceived and conducted another strategy, the conquest of hunger, more specifically, the improvement of agricultural production through the use of new high-yielding varieties of food crops. In the social sciences, a major strategy initiated in the thirties and continued for two decades, centered on the development of economic research, theory, talent, and applications. And in the humanities the Foundation pursued a pre- and post-World War II strategy to improve knowledge of foreign languages and cultures. This developed resources and leadership for intercultural programs in the U.S. and abroad in the 1950's and 1960's.

An important feature of such specific strategies, or concentration within the program fields, has been the attempt to put a particular problem or thrust at the center of interdisciplinary work, at different academic levels, and including both research and teaching. This involves academic reorganization where talents, resources, and programs in a university are restructured for effective focus on a selected subject or problem.

In the preceding chapter on innovations in education and research, Dr.Richardson has provided an excellent discussion, I think, of how directed mobilization can proceed. His explicit concern is with the environmental sciences. What he has said, however, about university organization or reorganization, would apply to a number of programs undertaken by the Rockefeller Foundation in the past. If one were to substitute "foreign area study" for environment whenever the latter term appears in his discussion, what Dr. Richardson has presented would apply to the Foundation's efforts at selected universities just after World War II. A little later, priority shifted from foreign area studies to international studies and Dr. Richardson has described what the Foundation tried to do in that direction.

We might conclude that problems as well as patterns of innovation in higher education have changed very little during the six decades of the Rockefeller Foundation's existence. But we are gradually learning how some of our more potent institutions—those of higher education—can keep pace with ever-changing needs.

2

ENVIRONMENTAL STUDIES* and the AMERICAN UNIVERSITY

Dr. Roderick Nash
Professor of History and Environmental Studies
Chairman, Environmental Studies Program
University of California, Santa Barbara

A witticism occasionally makes the rounds to the effect that in the typical American university it is almost impossible to do anything for either the first or the last time. The point is the inherent conservatism of established institutions of higher education. At first glance this is surprising. Higher educators are generally conceded to be among the most intelligent and creative members of a society. The name of their game is questioning, challenging, revising, and improving. Politically and economically they normally range far left of center. Yet when it comes to their own curriculum, internal organization, and research interests, professors frequently draw their wagons into a tight circle against innovating influences. As a consequence universities find major change, such as that involved in the interdisciplinary problem-oriented study of the environment, extraordinarily difficult. Discussion of some of the reasons for this conservatism may be of assistance in its transcendence.

THE MONEY GAME

Budgetary shortages almost always bring out the conservatism latent in most universities. In flush times alleged "luxuries" like environmental studies and other experimental programs can obtain substantial support. But cutbacks cause an academic community to fall back into the hallowed, non-controversial meat-and-potato subjects. And even in good times there is a special reluctance on the part of administrators to invest too heavily in new programs for fear they may prove passing fancies. Special terror resides in the possibility of making tenured appointments in an ephemeral field, where disappearance leaves expensive flotsam in the faculty. This is a legitimate concern, of course. The movement of academic resources into new programs should be studied and deliberate. But there is a delicate balance involved. If a new effort is not given reasonable fiscal support, if it is not allowed an autonomous voice in curricula and policy formation, if it is not permitted to recruit and appoint faculty, it may well be *made* a passing fancy. In this case the cause of the program's failure is not its lack of appeal to students, interest to faculty, or continuing relevance to society's needs.

One explanation for the typical university's disinclination to innovate is that it seldom enjoys enough financial independence to do as it pleases.

* *Environmentally oriented education and research can exist in a university in a variety of ways and under a variety of names. For simplicity's sake, this and other chapters of the present report occasionally use "environmental studies" as a generic name for all these endeavors.*

Consequently, universities are acutely aware of which side of the bread is buttered, and, in the main, that is the conservative, established side. The iconoclast, whether institutional or individual, often finds himself cut off from the financial means necessary to implement his novel ideas. Exaggerating to make the point, the institution, particularly a state-supported one, that today declared its intent to develop a college of gay studies or communist studies would threaten its own financial viability. Environmental studies is not as radical, but in view of its challenges to aspects of growth, private ownership, and the free enterprise system, there are risks involved. And universities are much more sensitive to the winds of public favor than they like to admit. The problem obviously is that the venture capital—the seed money—that underwrites innovation is not a common part of a university budget. This is a deficiency that philanthropic agencies have traditionally tried to overcome.*

THE BARS OF ACADEMIC FREEDOM

Another source of the American university's conservatism is surprisingly related to the democratic nature of the faculty community. Alexis de Tocqueville noted almost a century and a half ago that a society which makes every man a king experiences a degree of tyranny comparable to that of a traditional monarchy. The academic community is a case in point. Academicians loudly celebrate their independence, frequently cloaking it in the rhetoric of academic freedom. Praiseworthy as this attitude may be, it nonetheless makes creative leadership extremely difficult. There simply are too many chiefs. Each professor is the acknowledged king of his office, his courses, his laboratory. Without gainsaying the advantages of this independence, it is a situation that discourages aggressive leadership. Unlike a baseball manager or a corporation president, the university administrator (from department chairman to president or chancellor) religiously shies away from telling the persons that he administers what to do. Everyone on the teaching and research staff of a university is regarded as a "colleague." It follows that the kind of personnel and program manipulation normal in athletics or business is impossible. Proposals for change in an academic community invariably come *up* from the faculty rather than *down* from the administration.

The autonomous nature of individual faculty, coupled with wide divergencies in their views, means that only mild, compromise proposals have any chance of being made university policy. Major innovation, particularly that which steps on the toes of traditional academic patterns, encounters many obstacles on the campus. With every professor in possession of veto power, progress is frequently brought to a standstill. Ironically, liberalism in the sense of respect for the individual conspires to defeat liberalism defined as receptivity to change.

KINKS IN THE SENIORITY SYSTEM

The seniority system has long been recognized as a major retardant to innovation in the United States Congress. A similar emphasis on seniority, expressed in the professorial scale and the tenure system, discourages change in universities. Younger, untenured members of a faculty quickly learn that the road to security is paved with the good will of their senior colleagues. Boat rockers, especially those who by their iconoclasm implicitly criticize older faculty, tend to jeopardize their own futures. The irony of the situation is clear. The younger people with an abundance of energy and new ideas are seldom in a position to implement them on a university-wide scale. Bear in mind, too, that in contrast to the federal government there are no party systems, elections, or designated terms in office to alleviate the repressive influence of seniority. A chancellor, president, or dean hostile to a proposal can block it for decades. Change, another academic witticism holds, rides with the hearse, and university policy formation frequently proves this point.

While not officially sanctioned, as is the case with the Congress, seniority invariably prevails in the key committees and administrative posts that direct a university. The persons at the crucial points of leverage are almost always drawn from the senior faculty. Such men and women often have a considerable personal investment in traditional academic means and ends. They reflect the training they received in their graduate student years which are commonly three or four decades in the past. Subtle issues are involved. A professor who has developed thousands of pages of lecture notes is loathe to abandon them by responding to calls for change. A teacher whose confidence stems from many years of conducting a class in a familiar way fears dis-

* *For many examples see Merle Curti and Roderick Nash,* Philanthropy in the Shaping of American Higher Education *(Rutgers University Press, New Brunswick, N.J., 1965).*

comforting innovation. Jealousy also figures. Pious sentiments about small, high-quality courses notwithstanding, professors are in company with all people in liking popularity. An older faculty member is understandably reluctant to approve, much less encourage, curricula innovations that would help make him a relic. It is extremely disheartening for yesterday's star to see new faculty or programs "steal" away the students. The self-respect of a lifetime is at stake, and very often academic reform suffers.

THE STUDENT PHENOMENON—1970's

University students must also share some of the responsibility for their institution's conservatism. Although briefly in the late 1960's it appeared that the times might be changing, recent trends have done much to reestablish the phenomenon of the docile, unquestioning student and the professor-god. With grades, graduate schools, and careers once again dominant concerns, most students quietly accept the traditional formulas for teaching and research that are handed down to them. Few dare to challenge the assumption of professorial omniscience even when the professor's work fails to address the student's own pressing concerns.

Holistic, problem-oriented study of the environment is precisely the kind of endeavor likely to become a victim of university conservatism. First of all it presents a challenge to departmental structure. Since their development under Germanic influences in the late 19th century, American universities have been keyed to departments. Teaching and research, it was taken for granted, could be conveniently pigeonholed into separate categories. Entering undergraduate students were confronted with a smorgasbord of knowledge. They sampled at random or, after the institution of "general education" and similar programs, with an eye to diversity. No one worried about how the heterogeneous mass was digested. Few suggested integrative themes, like man-environment relations, to provide order and meaning for a course of study.

Graduate students, on the other hand, were expected to plunge into a single field or department with blinders firmly in place. From their professors they inherited the idea that narrowness of scholarship was synonymous with expertise. The final objective of the graduate student was to so refine a dissertation topic as to permit the writer to stand alone in his command of the subject. No one asked whether or not anyone cared.

MINI-KINGDOMS

In time the departmental structure was modified but always as the result of mitosis. Big departments became several smaller ones. Disintegration prevailed. Any attempt to reverse the trend, to promote integration, ran afoul of departmental boundaries. Among the most entrenched of any of the university's institutions, departments commonly acted as mini-kingdoms. Their control of the faculty reward system was absolute. The umbrella that colleges or other sub-university administrative units sought to provide for several departments only created arenas for their competition. Loyal department members take as their first axiom the enrichment of their empire in relation to that of the other departments. In the low- or no-growth budgetary situation prevalent in recent years at almost all universities, the axiom changed to *at the expense of* the others. Understandably this is a situation in which a new entrant into the competition for university resources, such as environmental studies, is not looked upon with keen appreciation.

The strength of departmental lines within a university also makes it difficult for all but the most intrepid faculty members to teach or to perform research outside their "home" field or in interdisciplinary ventures. Seldom does the old guard in a department acknowledge the legitimacy of such endeavors; rarer still is the person who is *promoted* by a department as a result of his achievements outside it. As a general rule the only professors whose part-time involvement in environmental studies is not a handicap are those whose accomplishments in their home department are unassailable. Given the strongly department-oriented world of the university, interdisciplinary endeavors necessarily take on the status of hobbies for the faculty involved. In transcending departments, interdisciplinary programs like environmental studies work against, and by implication criticize, the central organizing principle that is a characteristic of the traditional university.

ACADEMIC RESEARCH VS. SOCIAL NEEDS

Another dimension of the typical university's resistance to environmental studies is the challenge it poses for "pure" research. Without denying the value of all knowledge, it is possible to maintain that some kinds of knowledge are more valuable than others. The criterion is the need of society based on the problems it faces presently and those it antici-

pates in the future. Under the guise of resisting outside pressure and preserving objectivity, universities have often held back in bringing their awesome expertise to bear on pressing issues of the here and now. Faculty interested in environmental studies are usually among the leaders in deploring this lack of a service orientation in higher education. They contend that society has a right to expect the discussion and hopefully the solution of prominent issues as part of the higher education process. Society might also expect universities to train competent individuals who can deal broadly and professionally with these important, as well as complex issues at an interdisciplinary level.

As evidence of the potential rewards of university involvement in contemporary concerns, proponents of problem-oriented education cite the way schools of agriculture and public health arose in major American universities early in the present century and led the progress in these fields. In these instances the magnitude of social need simply overcame the universities' reluctance to move in practical directions. One conclusion is that environmental problems have not yet produced the same intensity of public concern. But it is also possible to blame universities for not fully accepting the responsibility of public leadership.

Advancing problem-oriented, interdisciplinary teaching and research in the environmental fields does not at all entail the deprecation of disciplinary endeavors. The aim is not to bypass traditional research but to integrate and coordinate it around environmental problems. Applied research should be understood as the concomitant, not the antipode, of pure research. According to proponents of environmental studies, the professor who does not conduct any research with an eye to its applied, real-world dimensions short-changes himself and his society. Also unfortunate is the researcher who is not cognizant of the interfaces between his work and that of others. Such statements appear innocuous enough, but they storm the ivory tower that has long been a precious part of university tradition, giving the institution faith in itself.

TEACHING OLD UNIVERSITIES NEW TASKS

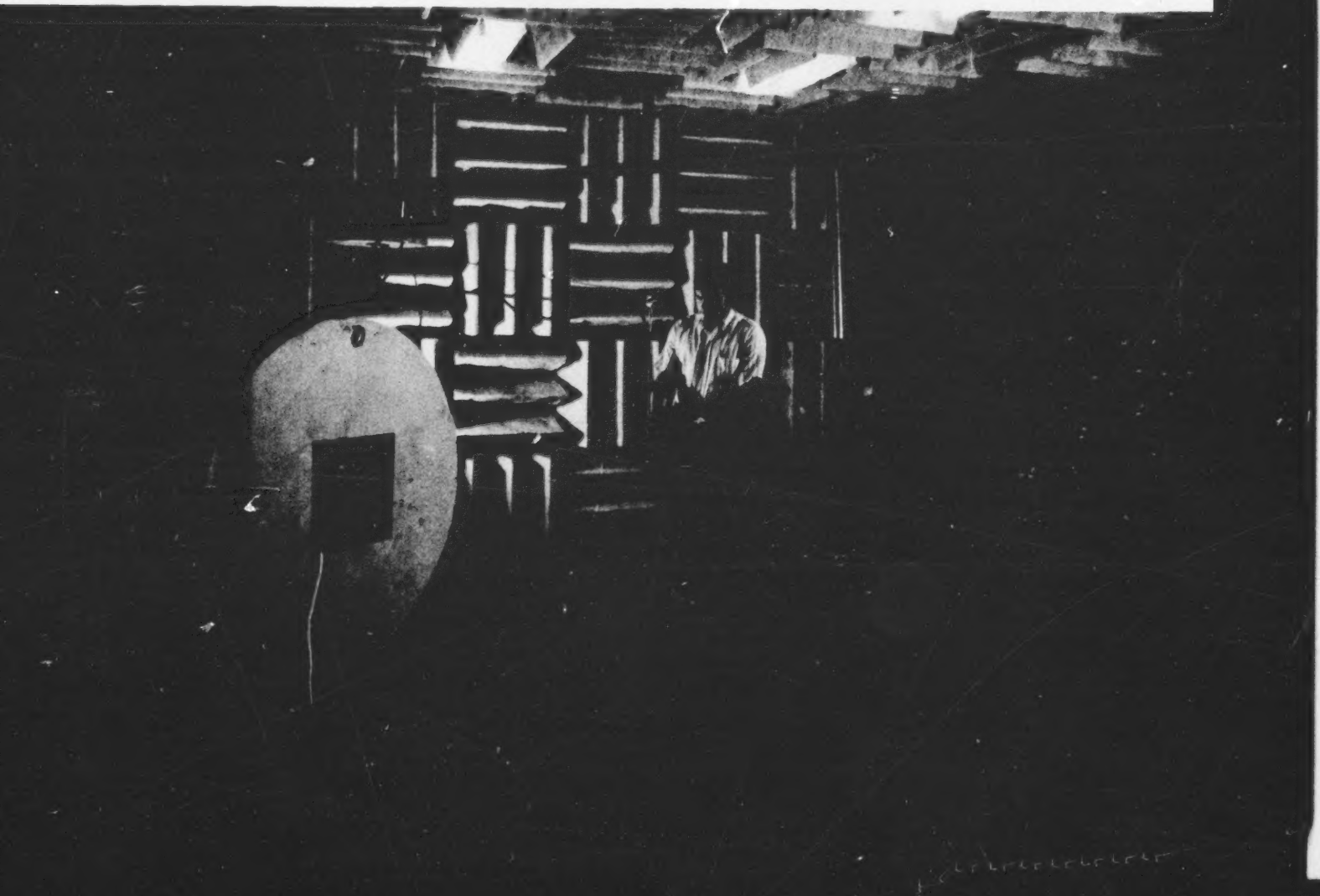
The remainder of this report will expand upon the reasons for the uneasy relationship between environmental studies and the American university. There are indeed grounds for pessimism. The historically minded cannot avoid recognizing that major changes in higher education in the past have, time and again, depended on the founding of new colleges and universities. The old ones simply would not change. For example, neither women nor a technical and commercial curriculum could crack the doors of the established institutions in the middle decades of the 19th century.* As a result, wealthy benefactors launched new colleges to accommodate these reforms, and in time the older schools followed suit.

In recent years the same strategy has worked to develop environmentally-oriented teaching and research programs. Entire campuses devoted exclusively to the interdisciplinary study of man-environment relations have appeared on the academic map. Such fresh starts give full rein to change, but the new "environmental" colleges lack the disciplinary and financial strength of established universities. Moreover, the new campuses need the assistance of their larger and more prestigious colleagues in furthering the technical and attitudinal revolutions basic to the attainment of environmental quality.

In seeking ways of advancing environmental quality early in the 1970's, the Rockefeller Foundation might have attempted to launch a new university dedicated to environmental studies. Instead it opted for the more difficult task of encouraging innovation in large, firmly established institutions. The results of the four-university program described in these pages can be termed encouraging. While the rate and scope of the change will not please everyone, the universities involved have been helped to see that new directions are possible. Such recognition carries with it the hope that the full potential of higher education can in time be realized in the vital task of building long-term harmony into man's relationship with his environment.

* *Curti and Nash*, Philanthropy in the Shaping of American Higher Education, *present the full story.*

Rural Pennsylvania supports diverse agriculture as well as the largest non-farming rural population of any state in the nation. Below: The university's excellent acoustics staff and facilities were employed in investigations on effects and control of environmental noise.



3

THE OFFICE OF ENVIRONMENTAL QUALITY PROGRAMS at the PENNSYLVANIA STATE UNIVERSITY

Dr. Richard D. Schein
Director
Office of Environmental Quality Programs

THE NEED FOR ENVIRONMENTAL PLANNING

Many of our environmental struggles today are attempts to ameliorate yesterday's problems—those born of our ignorance of the environment's delicate balance, which was established through millions of years of trial and error. As a society, we did not, in the past, fully consider that smoke in the air, chemicals and sewage in streams, and scarred hillsides caused by highways, quarries, and mines are a dangerous and cumulative price to pay for goods and services. In short, our thinking has not been comprehensive; and we have proceeded without wise, long-range policies to guide us.

Now it is obvious that environmental planning is urgently needed, and that this planning must be based on well-integrated policies. But who or what institutions are capable of formulating them? Government agencies and legislators try. But do the results work? Certainly they fall short of perfection if today's problems are the measure of yesterday's policies. We think universities have a responsibility and a role here.

A university's environmental role is not to extinguish brush fires but to educate the public so that it can make wise, long-range decisions. With large resources for research and education, a university can establish guidelines for intelligent planning, good legislation, and fair regulation by those outside.

THE PENN STATE ENVIRONMENT PROGRAM

The motives and goals of The Pennsylvania State University's Rockefeller Foundation assisted efforts in environmental affairs were developed during a period of almost a year and a half of conversations and letter exchanges between officers of the Foundation and faculty and senior administrators at Penn State. Initially, the Foundation had expressed strong interest in the establishment at Penn State of a single, large, central environmental affairs institute from and through which would be operated programs in undergraduate and graduate education, research, and public service and extension. Penn State administrators had second thoughts about such an operation, arising out of their experience in the administration of colleges and intercollege research organizations, and from their knowledge of the academic-political infrastructure at Penn State.

We proposed instead a staff rather than line of-

fice, reporting directly to upper levels of the central administration, an office with a clear prerogative to encourage that necessary, multidisciplinary, multicollegiate cooperation and interest upon which credible environmental programs must depend. The director of the Office of Environmental Quality Programs [hereafter OEQP] often acts like a broker who, aware of a problem and goals, brings together the proper body of people and resources to accomplish the task. He often feels like a shuttle moving within the great loom of the university, interweaving into that fabric the particular configurations and designs for the prosecution of environmental matters.

The OEQP rests upon the recognition that in environmental affairs, The Pennsylvania State University has a high degree of activity and an even greater potential in all of its functional areas—instruction, research, and public service. Greater effectiveness will come with greater cooperation among departments, colleges, or functional areas.

In recognition of these needs and opportunities, the OEQP is established as a unit of the office of the Provost. Among the functions of the director are the determination of inter-unit or inter-area needs and capabilities, the facilitation among departments, colleges, and inter-college organizations, and the encouragement of cooperation among such units.

These functions shall be carried out by the director in a manner consistent with university policy in instruction, research, and public service. In environmental areas new inter-unit projects and activities will be necessary. In some cases, these will need new or revised policy. The director must therefore be in close communication with the vice presidents in charge of the three functional areas of undergraduate studies, research and graduate studies, and continuing education in the university.

These three officers are part of the Administrative Committee which will work with the director to assure strong and beneficial operations. For reasons of communication and advising, they will be joined on the Administrative Committee by the dean of the Graduate School (representing the Graduate Council), a member designated by the Council of Academic Deans, and a member designated by the University Faculty Senate.

The Administrative Committee renders broad-based support to functions and operations of the OEQP and helps assure the quality of the effort. When environmental programs (proposed or actual) involve more than one functional area—undergraduate education, graduate studies, research, or public service—the committee shall serve an advisory or policy function, or both, as needed. The committee assists in stimulating broad university commitment and interest in environmental affairs, in the determination that proposed programs are in the best interest of the university after review by collegiate and departmental officers, and in the resolution of conflicts. It meets at least once each term.

Early Interests That Paved the Way

Before receiving support from the Rockefeller Foundation, the director of OEQP spent almost a full year studying and evaluating environmental activities at Penn State. As a land-grant university it has a long history and a large faculty in such obviously environmentally related areas as agriculture, engineering, basic sciences, and the earth and mineral sciences. Already erected, beginning in the early 1960's, were a series of intercollege research institutes, three of which were directly environmentally related: the Center for Air Environment Studies, the Pennsylvania Transportation Institute, and the Institute for Research on Land and Water Resources. The latter included the Pennsylvania Water Center as created under the Water Resources Research Act of 1964. In addition, some colleges are truly multidisciplinary and in the past have been able to mount large projects of research and education with superior representation of necessary fields from within single colleges.

AREAS FOR CONCENTRATION

We saw in the Foundation's grant the possibility of adding an extra increment of quality and quantity to our environmental activities in areas where we judged we had an accumulation of experts and knowledge nearly sufficient to allow us to proceed uniquely, that is without being redundant of programs in other universities. We identified some areas in which we would concentrate research activity.

Environmental Policy

We found a considerable awareness on our campus that, although we had great technical expertise in the science and technology of the environment, the solution to society's problems would depend upon decisions in the social sphere. We proposed to erect a new intercollege research institute, the Center for the Study of Environmental Policy, which would concentrate its efforts in the social, economic, legal, and behavioral sciences, drawing heavily on advice from persons in the sciences and technologies.

Aquatic Ecosystems

We discovered an opportunity to bring together a group of faculty and students, under the aegis of the Institute for Research on Land and Water Resources, to develop an area of competence in aquatic ecosystems research and management.

Solid Waste Management

We found a considerable number of our faculty concerned for the future in this area. At the time of initial funding it had been our hope to assist these people in their initial efforts, including exploratory research, to develop ideas and competence sufficient to attract significant federal research funds, which at that time were expected to be forthcoming.

Environmental Noise

We discovered we had a small core of people in acoustics, physiology, and psychology, with considerable experience in the effects of sound on human beings, who wish to work together in this rather neglected area.

In addition to these research areas we proposed to place major emphasis on public service. We knew that through our Agricultural Extension Service and our Division of Continuing Education we had been providing environmental advice and education, including radio, television, and conferences, in large amounts for many years. We were not completely sure of the effectiveness of these programs, and we pledged to give serious attention to this during the period of the grant, in a study which might result in new university policy regarding its posture and philosophy of public service activities in the environment.

A BRIEF CRITIQUE OF THE NEW EFFORTS

Center for the Study of Environmental Policy

It was not easy to establish this center as an intercollege unit because Penn State has about ten social science departments in at least four colleges. The director of OEQP persuaded the heads of these departments that an inter-college research operation would be beneficial and not detrimental to the departmental operations. Ultimately, the justification for the establishment of the new center was written by a special committee of all social science department heads, and a subcommittee of that group recruited a young and active director for the center from outside the university. The center has been in operation only about a year and a half, but already is attracting other third-party research funds and is indeed bringing together faculty and students from different social science areas, which means different departments and colleges.

Department Boundaries

The difficulties are far from over. Penn State's tradition of research in the social sciences presents an uneven mosaic. In some departments the tradition of research is long and well established. Some personnel from these departments show great willingness to participate in intercollege research efforts, but most have developed ways to carry out their research within the confines of their own disciplines. Other of our social science departments either do not have a strong research tradition or have developed a strong tendency to stay within the boundaries of the discipline. Older and more mature scholars are comfortable and confident in the areas of competence they have developed and are not easy to tempt into boundary areas and interdisciplinary research. At a time when faculty position funding in universities is quite restricted, growth of environmental policy research may be slow because insufficient funds are available to hire younger scholars interested in environmental affairs and not yet academically entrenched.

University Speculation

We considered the development and operation of this new center to be a risk opportunity, almost speculation. If that speculation was well based and paid off, the university would gain new academic riches; but if that speculation found itself operating in a hostile political and academic climate, the operation might fail.

It is too early to judge; certain signs are very encouraging, not the least of which is a better relationship between the university and important state and federal agencies. In our opinion, the development of the center depends very much upon the leadership of a very active academic entrepreneur, who must at the same time understand the role of the university and its faculty and the kinds of research activities which are appropriate to a university.

Pilot Program: Pine Creek Watershed

To give the new center a focus, an effort was made to identify projects which, if undertaken, would demand and use skills within our university. The

The Pine Creek watershed, proposed for inclusion under the National Wild and Scenic Rivers Act, has been the site of intense research and student training on biological and social forces affecting the environment in this central Pennsylvania region. The area is typical of much of the eastern United States in that it is being transformed by highway development, changing economic emphasis for agriculture, mining, and forestry, as well as by second home development and recreational pressures.

problems would have to be broad enough to be challenging, but small enough to be manageable. Such projects might fall within the category of air, water, or land policy studies; or they might have a geographical emphasis.

We found that Penn State has a history of concern for the nearby Pine Creek Watershed, and as a result, has produced a significant data base in the physical, biological, engineering, and social areas. With these data as a foundation, we should be able to expeditiously develop a long-range environmental policy for Pine Creek, complete with costs, benefits, trade-offs, alternatives, and predictions.

While this project will try to provide solutions for Pine Creek, it also will function as a pilot program, which can later contribute valuable information and ideas to similar projects in Pennsylvania and the nation. At the same time, Penn State researchers will benefit from the findings and their applications.

The following are objectives for the Pine Creek Water Shed. We feel that they are reasonable and obtainable.

Preserve key private lands through easements, purchase, zoning, or other means.

Preserve public lands by having them designated as wild areas.

Improve the water quality of Pine Creek with good sewage treatment plants for large communities and efficient septic tanks for individual homes. Pollution-control laws need to be enforced.

Eliminate acid mine drainage. More inspectors, with better training, are needed to see that the clean-streams laws are properly enforced.

Preserve and enhance the north Pennsylvania character of the villages.

Plant trees and flowers. Create parks and commons. Restore old buildings, some of which are historical. Control the number and appearance of signs on buildings and along roads so that they are esthetically pleasing and blend with the surroundings.

Encourage suitable locations for, and the design and appearance of, new commercial and recreational facilities.

Promote native crafts.

Plan well for road improvements and hiking trails.

Propose a link-up of inns along certain trails so that hikers can walk the gorge during the day and rest, eat, and socialize at night.

Promote environmental education in schools and in local civic, youth, and church groups.

This is only an outline of what might be done in Pine Creek. A coordinated study such as the one Penn State proposes for Pine Creek could flesh it out into a comprehensive environmental policy. Such a study is rarely attempted and would be quite an achievement if it succeeded.

The Sad Lesson of Brandywine

Many people know of the Brandywine project. A foundation gave a large grant for studies of the Brandywine Watershed in southeastern Pennsylvania and northwestern Delaware. The studies were done and the results reported to the residents in the hope that they would act to protect their watershed. But this never happened, because the residents did not want to be told what to do. A Penn State professor says that at least part of the problem was that no one on the project had bothered to keep the residents informed of what was going on and why; furthermore, it seems that no project member had bothered to take residents' considerations into account during the studies. The human factor was just forgotten. A lot of extremely valuable information was never used, and a lot of effort and money were wasted.

There is no need to repeat the mistakes of the Brandywine project. We don't think that will happen. The foundation for working with the people of Pine Creek has already been laid; every group or individual from Penn State doing research in the area has involved and informed the citizens.

The greatest challenge to the Office of Environmental Quality Programs in dealing with Pine Creek is integration of the university groups and interests at work in the watershed. The Center for the Study of Environmental Policy is concerned with social, legal, and political questions. A team of biologists is investigating a wide range of questions concerning the basin and experimenting with modeling techniques. Finally the Pennsylvania Water Center, which is a research group in the university, has brought together a team on aquatic ecosystems consisting of a fisheries biologist, a sanitary engineer, a hydrogeologist, a forester, and a sanitary microbiologist. Each has students working on Pine Creek in addition to his own efforts. As the research reports of these various endeavors are being written, we see more clearly that although some dialogue between the participants has occurred and the perspectives of faculty and students have broadened, more might have been done through early and regular seminars.

Solid Waste Management

We did not spend a great deal of money in this area. Attention to agricultural wastes is rather well

established in the College of Agriculture and the projects have sufficient funding. We provided funds for released time for a senior faculty coordinator, who got to know the faculty and their interests and attempted to find possible third-party funding sources for studies of domestic solid waste management. Rather unfortunately our efforts coincided with the establishment of the federal EPA, and that new agency took some time to settle down and establish its personnel, priorities, and programs, including its policy of university research support. Several proposals were generated because of interest at agencies, only to find later that either the agency had changed its mind or its senior personnel had changed, or both.

Recently the coordinator has been attempting to develop interest from industrial organizations, and there is some possibility that this effort may bear fruit.

5,000 Tons of Waste Paper

An interesting and successful study was carried out locally with Foundation funds, as well as funds from the university. An operations researcher, a sociologist, and a graduate student in sociology have completed a study related to the recycling of the something like 5,000 tons of paper generated annually within the university. It is definitely a possibility that the management scheme they now propose will be adopted and that the recycling scheme will cost the university little if anything. Through this effort our people have gained experience in this difficult research area, and we hope their results are exportable to like institutions, namely other universities, and government and industrial offices, all of which generate a great deal of waste paper.

Environmental Noise

At the end of the first year of this activity, the director of OEQP judged that efforts under way with Foundation assistance were not apt to result in true multidisciplinary research efforts. Yet we were still convinced that we had a unique opportunity. The Center for Air Environment Studies judged that environmental noise could be within its purview, and the director of that center undertook to create a subgroup in environmental noise. This second effort has been more successful, has brought about multidisciplinary research and dialogue, and has resulted in new proposals for unique research. Here again we must point out the difficulty of getting mature scientists, comfortable and confident in their own fields, to move to the boundaries of those fields and work cooperatively with other scientists and, if appropriate, with social scientists and humanists.

In all of the above efforts there are certain measurable and immeasurable effects upon our academic programs. Some new courses have been developed and taught. A number of graduate students have received degrees. Students participating in those programs have been involved in discussions, research, and seminars which were multidisciplinary in nature. The outlook for the future is brighter because of the successes of some of the efforts and the changed perspectives of faculty and students, department heads, and other administrators.

Public Service Activities

Penn State has both an Agricultural and Home Economics Extension Service and a very large Division of Continuing Education; the head of the latter is a vice president of the university. In the past, these two agencies have worked quite independently and according to different modes. The Extension Service has its array of county offices and county agents and their staffs, as well as the central Extension office on the campus and its staff of specialists. The Extension Service tends to work in a programmatic and person-to-person way. It has definite programs and proceeds systematically toward their goals.

The Division of Continuing Education is a more reflexive service of the university. Its staff, as well as members of the university faculty, develops *ad hoc* special programs as they become aware of some clientele group's need for continuing education services. Its greatest activity is in what is called the informal program, the program of conferences.

Taking on New Responsibilities

In recent years the faculty of the College of Agriculture and personnel of the Agricultural Extension Service have become more aware of the negative role agriculture has often played environmentally, and of the opportunity and responsibility for College of Agriculture personnel to provide sound environmental advice. A special reorganization has taken place in the college, with the creation of a Coordinator of Environmental Quality Affairs. To assist with new goal achievement, Foundation funds have been allocated to a two-year program of retraining a cadre of about thirty county agents in agriculture and home economics who have been given regional responsibility for the delivery of environmental advice through county agents' offices. This program is

showing signs of great success as it progresses.

The situation in Continuing Education, because of its different mode of operation, has demanded further study. In the past year we have had many persons working, in an effort to help us decide whether particular actions should be taken in regard to this service. These committees have taken a three-year retrospective look at what we have been doing in conferences, face-to-face advice, the use of media in extension, and in correspondence courses. We are at once amazed by the sheer bulk of what we have done, but still confused as to whether or not our efforts might be better were they programmed to meet certain environmental education goals, etc. The analysis and report is now being generated. It seems likely that it will be recommended that the university establish a coordinator of environmental extension activities, whose job it will be to be continually aware of public education needs, and to work rather like the director of OEQP in bringing to bear on these problems the wide range of skills resident in the university.

During these three years we have become increasingly aware of the need for greater public education in environmental areas. That need is expressed strongly by citizens of the state. As a land-grant university we have a mandate to provide it through these two extension services. We would judge that land-grant universities have not only an enormous potential and opportunity in providing public education in environmental matters to students outside the campus walls, but a great responsibility as well.

Only One Earth

The OEQP's commitment to public service has also been expressed through support of a quarterly magazine called *Only One Earth*. This magazine, now three years old, is a high quality production and devotes most of its space to popular reporting of environmental research and other activities within the university. It has been extremely well received and we get very complimentary "fan" letters. The little periodical is not expensive, and we feel it has added another dimension to our public environmental education activities. We expect that it will continue as a regular university project.

Student Environmental Counseling Organization

Picking up an idea developed at the University of Michigan, we have established a Student Environmental Counseling Organization which would allow graduate students in the university to gain practical experience while pursuing their degrees, while at the same time rendering a service to society. We do not know yet whether or not this organization can become free-standing. It is doing needed projects and the student and faculty response is excellent. We like the idea very much, but cannot yet predict its future. This activity depends upon a motivated graduate student entrepreneur who can foster his colleagues' interests without involving the university in controversial community action projects.

We have used rather minor amounts of funds to assist some public service activities which have come up during the life of the grant. We have funded some special conferences and some television activities, provided means for Regional Planning students to assist in the development of a plan for a rural community, and other like matters.

ACTIVITIES NOT FOUNDATION ASSISTED

The OEQP has been extremely active with its responsibilities outside the Foundation-assisted program. The director has participated in many conferences and has appeared as an environmental speaker. We have brought together many people who proposed activities related to the environment but not eligible for assistance from our Foundation grant. We have helped achieve a greater relationship between the university and state agencies related to the environment. We have participated in the formulation of the State Environmental Centers Act, and have advised the president, the provost, and vice presidents of the university on various university matters related to the environment.

The OEQP attempted to bring university-wide attention to the matter of undergraduate education in environmental matters. We have not been successful in the development of an intercollege multidisciplinary program which might be called "Environmental Studies" or "Environmental Sciences." Our faculty is conservative. The Senate Curricular Affairs Committee could not be convinced that there really is a field called Environmental Sciences or Environmental Studies, and despite a great deal of work by very many people, no new programs are operating in this area. The OEQP has, nonetheless, helped focus greater attention on environmental matters in existing programs of study. We encourage the development of some new environmental courses, and make available to students and advisers an up-to-date list of courses. We thus find ourselves participating in the slow evolution of an environmentally-oriented undergraduate curriculum.

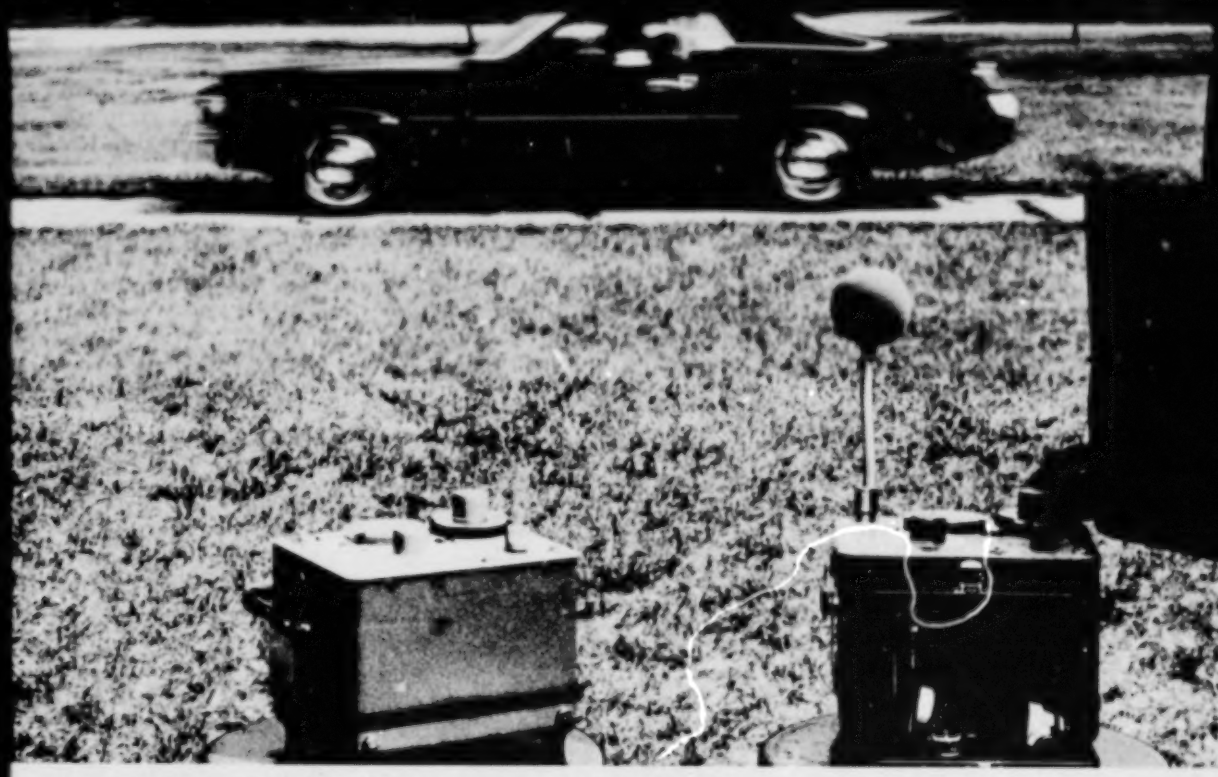
FUTURE DIRECTIONS

Our greatest environmental ability is in the sciences and technologies where environmental concerns have been traditional. There is no continuity of communication between individuals in these fields and their colleagues in the arts, humanities, and social sciences. The assisted research programs would have been better had the "other culture" been a participant and contributor. We are now making two efforts to gain attention in the arts, humanities, and social sciences, in the hope that once that attention is achieved, persons in these fields will be more readily attracted to multidisciplinary research teams. We are funding the development of a course on "wilderness and the technological mind" which will be part of our Science, Technology and Society series and will be taught by four faculty members: a biologist, a sociologist, a philosopher, and a psychologist. A recent planning conference built around the visit of historian Dr. Roderick Nash achieved an excellent dialogue among people from as many different scholarly fields, including science and technology. Not only are we achieving a faculty dialogue, but the results of that dialogue will be transmitted to students in a formal course.

A second effort consists of support to the Department of Art to develop a multi-media environmental presentation. We are confident the presentation itself will be exciting and will provide quite another dimension to environmental education; but the major purpose of the project is to bring the attention of people in the arts to their role in environmental education and to bring them into close communication with persons in the fields of humanities, social sciences, sciences, and technologies.

If OEQP has had some success, and we think it has, that success is based on two important items: the visibility and support for environmental affairs provided by the central administration in establishing the Office where it is and in giving it such free-ranging abilities; and the availability of funds from the Foundation to support activities in areas where the director had encouraged faculty interest. We called this the "Director's Discretionary Fund" and it allowed us to "put your money where your mouth is."

Universities rarely allow such discretion to any but the most senior officers. If the director has any feeling of personal accomplishment and happiness it is in looking back at those now established activities which clearly would not exist had our Office not existed.



Professor J. Bolt (above) and law students developed a model statute for the control of vehicular noise pollution. Below: Computer technology is used to understand algal population dynamics, an important factor in water quality. Drs. Stoermer and Johnson examine photographs scanned for optical density. The computer compares digitized cell patterns with known algal images.

4

THE INSTITUTE FOR ENVIRONMENTAL QUALITY at the UNIVERSITY OF MICHIGAN

Dr. A. Geoffrey Norman
Director, Institute for Environmental Quality

WHAT IS THE ENVIRONMENT?

"Environment," literally "that which surrounds," includes all conditions and stimuli that affect human life, whether natural or man-made, whether man is aware of them or not. Until very recently in human history, man lacked the technological and social means of altering his natural environment in ways that could produce dangerous and far-reaching side-effects. During the past century, and particularly during the past fifty years, the development and unwitting application of these means has produced some of those effects. Twenty years ago, a few scientists were warning of ecological dangers inherent in the productive and consumptive activities of a relatively unrestricted technocracy. Today almost every citizen is aware that almost all aspects of his total environment—natural, biophysical, sociopolitical, aesthetic—have been deteriorating at an unprecedented rate, and that immediate and sophisticated action is required to halt and where possible to reverse this process.

How is a Quality Environment Defined?

Judgments of environmental quality are individually subjective, though ultimately objective in a biological sense. A problem of environmental quality is said to exist when our view of actual conditions does not conform to our view of what they should be. Our view of what they should be derives from an awareness of what may endanger our physical, social, or cultural wellbeing. Our recognition of these threats depends upon our capacity to perceive, measure, and evaluate them. Yet whether or not a dangerous form of pollution or deterioration is recognized, it is an objective threat. Part of the current social anxiety about environmental quality stems from a widespread feeling that these as-yet-unperceived effects of a deteriorated environment may be more serious than those already discovered. This anxiety is compounded by a feeling that existing social and political institutions are not responsive enough to cope effectively with existing environmental problems. The Institute supports activities aimed at finding solutions for all of these problems—social and institutional, as well as scientific and technological.

WHY AN INSTITUTE FOR ENVIRONMENTAL QUALITY?

The Institute assists in focusing the resources of the university on complex problems associated with

improving the quality of our natural and sociocultural environment. It does this by encouraging and supporting multidisciplinary teaching, research, and service activities designed to provide answers to a two-part question: How might current and future problems of environmental quality be solved, and how can the scientific, technological, educational, legal, political, economic, and social forces essential to such change be marshaled?

How is the Institute Organized?

The Institute was established by the Regents in March 1970, with funds provided by The Rockefeller Foundation. Its purpose is to provide initial support for scholars and students interested in new and interdisciplinary approaches to environmental problems. Its director is assisted by a Policy Committee composed of the vice-presidents for Academic Affairs and Research and the deans of the several schools and colleges with programs relating to environmental quality. Guidance is provided by an Advisory Committee composed of nine faculty members and four graduate students. Academic units currently represented by members of the Advisory Committee include Natural Resources, Electrical Engineering, Industrial and Environmental Health, Zoology, Physiology, Atmospheric Sciences, Psychology, and Urban Planning. Through rotation there is wide involvement of units with environmentally oriented activities and interests. The director is appointed by the Regents upon recommendation by the president.

What Kinds of Support Does the Institute Provide?

In keeping with the objective of stimulating interdisciplinary activities, including both training and research in fields basic to man's understanding of the environment and the maintenance of environmental quality, the Institute grants fellowships for highly qualified advanced students, provides some initial funding for research projects of faculty and students, and catalyzes the assembly of research groups responsive to external funding opportunities.

Institute Fellowships

The Institute awards one-year graduate fellowships, renewable for not more than two additional years. In the four years since 1970, thirty-one students have received fellowships to support studies in a diversity of fields. Preference is given to students whose studies combine two or more areas of competence. For example, candidates whose studies combine law, political science, economics, research planning, or engineering with studies in the natural, biological, physical, ecological, or social sciences are given preference, although no discipline is excluded *a priori*. Most Fellows are candidates for the doctorate or another professional degree, although especially well-qualified first-year graduate students are not excluded from consideration. Most Fellows are already University of Michigan students, but they may be from other universities and may be foreign students. The overriding criterion is the relevance of the student's proposed program to important problems of environmental quality.

Institute Support for Faculty Research Projects

The Institute provides grants for research efforts that relate to or underlie problems of environmental quality, and particularly for projects that are innovative or involve new disciplinary alliances. The grants are of the nature of "seed money" so that new ideas or strategies can be adequately tested or sufficient data accumulated to make feasible a proposal for extended funding from other sources. Included would be efforts to develop interdisciplinary participation, or to apply new techniques to environmental problems, and studies of actions that might be taken on the basis of analyses of social, political, economic, legal, and other conditions. Projects that provide opportunities for student involvement are given some preference. In the four years since 1970, twenty-nine faculty research projects have been funded by the Institute at an average figure of about $7,000.

In general, the Institute does not support planning efforts for new courses, symposia, or curriculum development, although it can provide other kinds of help. Nor does the Institute provide support for laboratory and other equipment, except in special cases. Although projects involving certain kinds of data systems, extensive surveys, and monitoring of physical and other conditions on a broad geographic scale are very important activities in the field of environmental quality, these activities usually require continuing operations best conducted by public agencies or private enterprise. Research supported by the Institute can play a useful role by analyzing existing conditions and recommending to government and private agencies certain lines of needed research and action. The Institute has no formal deadlines or format for applications for research support.

Other Institute Activities

The Institute is charged with fostering activities in the university that bear on environmental quality. Other than administering the programs described in the previous sections, its role is one of catalysis and coordination. Federal agencies and other sponsors of research are increasingly focusing their attention and support on the solution of problems relating to the environment, and to satisfying what are perceived as national needs in the environmental field. It is still true that the universities are the prime performers of basic research and of much of the applied research in this country. To respond to the new opportunities, research groups of somewhat larger size with diverse disciplinary competencies are required. The Institute develops such groups and, when necessary, acts as the administrative unit for their activities. Additionally, it fosters student-initiated projects of relatively short duration, such as the review of public policy or the thrust of law in contemporary environment problems, and the involvement of student groups in the collection of data bearing on local environmental issues.

The university has great strengths in many fields that are supportive of or basic to knowledge about the biosphere and the changes impressed upon it. These strengths have not been brought together administratively to form a new school or college because to do so might weaken existing professional programs. Course offerings and curricula structures, therefore, are the responsibilities of the schools and colleges, but the Institute can be helpful in their formulation and modification.

More specific examination of the Institute's functions may be made under its three major concerns:

(1) fellowships for graduate students with career motivation or research topic requiring interdisciplinary work
(2) faculty-student research grants for innovative projects
(3) assistance in the acquisition of new faculty

Fellowship Program for Graduate Students

Most predoctoral fellowship awards are closely tied to disciplinary or department interests. Students wishing to pursue a career in the field of the environment and desiring to prepare themselves to address problems relating to environmental quality have generally not received fellowship awards. Moreover there may be for them academic penalties, inasmuch as the requirements of interdisciplinary preparation may be more numerous than in conventional fields. The predoctoral years may be lengthened, even though the graduate school has been liberal in approving individually tailored programs developed by a faculty committee essentially selected by the student as covering his or her interests.

The availability of a small number of fellowships for predoctoral interdisciplinary environmental studies generated a substantial number of strong applicants. Ten fellowships were awarded for the 1970-71 year. This figure was increased to a total of 20 for 1971-72 and to 21 in 1972-73, new appointments being made as replacements for those completing their studies. In the 1973-74 year, there were no new starts, but 14 appointments were continued. Over the four-year period the total number of individuals supported has been 31. To date 14 have received the Ph.D. degree, 1 J.D. and M.S. (Resource Economics) concurrently, 1 Master Urban Planning. Ten more will complete the doctorate requirements in 1974-75.

In order to ensure quality control the fellowship application and primary selection process has been handled by the Fellowship Office of the H. H. Rackham School of Graduate Studies. The basic fellowship conditions are essentially those applicable to the National Science Foundation and National Institutes of Health fellowship programs. The final selection takes into account the particular program of interdisciplinary studies which the student elects to pursue, his or her career objectives and some assessment of the strength of commitment to that goal.

The fellowship program is now in its fourth year. There was clearly a need for the opportunity which these fellowships provide and they have come to be regarded as the first source of support to be turned to by graduate students with environmental interests. There is a measure of self-selection in the decision to apply. This and stiff competition has resulted in the appointment of an unusually able group of young people. It can be predicted with confidence that many of these students will move into positions that will utilize directly the environmentally-oriented training which they have received. A university serves society by ensuring the production of men and women trained as well as we know how to meet the requirements of the world in which they will live their professional lives. This program is directly aiding the university to enlarge the flow and improve the training of specialists in fields that relate to the quality of man's environment.

Faculty-Student Research Grants Program

Although the university has limited discretionary funds to initiate new research activities by faculty and students the total available has been far short of the needs in an institution with a large and diverse research enterprise. Designation of a portion of the Foundation grant for this purpose has made it possible to give more attention to the fostering of research on environmentally related problems and to aid some faculty members to move their efforts to this field. Environmental problems are inherently complex and often call for a team approach. Projects that involved new disciplinary alliances or innovative but untested approaches were given some preference. The projects supported were not expected to be completed investigations. Rather they were to be carried far enough to establish the validity and promise of the research strategy proposed. In a real sense these funds were therefore regarded as seed monies in the expectation that continued funding would come subsequently from other sources. In determining projects to be supported, preference was given to those involving students as participants. However these grants were not intended to support dissertation studies. Proposals were subjected to internal review by two or three peers generally knowledgeable in the field, with the final decisions being made by the director. The average grant was about $7,000, in each case expenditures being made in conformity with an internal budget. No academic year faculty salaries could be charged.

A number of student-initiated projects that would further individual or community interests and at the same time enhance student training or experience were also funded using rather different criteria. These were developed with faculty advice but not necessarily close supervision. Most of these had modest funding with an average of about $2,300.

Assessment of the effectiveness of an internal grant program can be made in a variety of ways. Viewed as risk capital ventures, one can look for the subsequent funding from other sources, or one can look at technical papers published, but neither of these necessarily measures the influence on the individuals involved, particularly the students. To them, especially, there is the demonstration that alleviation, solution, or management of environmental problems depends on the understanding of the phenomena or principles involved, and that much environmentally-oriented research does not differ in this respect from most basic and applied problems in the physical or biological sciences.

Not all the projects were successful; some at least have opened up new developments and some of these have received continued funding. Grants totaling almost four times the Foundation funds allocated to the internal grants program have already been received and more will follow. It is, however, a fair comment that despite the recognition of the prominence of environmental issues in our national life there has not been a commensurate increase in research funds relating to environmental quality. The NSF-RANN awards are mostly large and circumscribed; EPA support tends to be directed toward regulatory aspects. Other agencies do not seem to have moved toward increased funding of academically-based, environmentally-directed research.

As for the student-focused projects, one can only say that these were supported as being of educational value and providing worthwhile opportunities for individuals who have a deep commitment to environmental issues. It is unlikely that any of these projects could have been supported from university funds. The relatively modest total expenditure in this category was, therefore, especially valued.

In conclusion, the judgment at this time would be that the availability of limited internally-awarded support for environmentally-related studies has stimulated faculty and student activities, has resulted in cooperative interdisciplinary work and already has had some successes in terms of new funds granted.

Acquisition of New Faculty

In 1970 the university expected to add within the next few years a number of new faculty positions in fields relating to the environment, and particularly in interdisciplinary areas using Foundation funding on a declining support basis. Subsequent university budgets have contained no incremental monies for new appointments in this area and made forward commitments for pick-up of salaries difficult. The following additions to the faculty have been made with the aid of grant funds.

David M. Gates—Professor of Botany and director of University of Michigan Biological Station, 1971—Dr. Gates is basically an environmental physiologist concerned with the energy balance in plants and ecosystems, for a number of years director of the Missouri Botanical Garden. Dr. Gates is a distinguished scientist, a member of the National Science Board, and until recently Chairman of the

Environmental Sciences Board of the National Academies of Science and Engineering. Although his appointment was in part a replacement, the financial aspects were such that it could not have been accomplished without a substantial phase-in over a three-year period from grant funds. Dr. Gates has a multi-faceted research program under way on campus and at the Biological Station.

Robert H. Williams—Assistant Professor of Physics, 1970—Dr. Williams came from the National Center for Atmospheric Research and the University of Colorado as a theoretical physicist concerned with physical aspects of environmental questions. He has developed courses on energy conversion, energy needs, and environmental thermodynamics, has prepared a book on the subject of energy, and currently is on leave in Washington as a member of the group working on the national energy problem under Ford Foundation funding.

Donald H. Stedman—Assistant Professor of Chemistry and Assistant Professor of Atmospheric and Oceanic Sciences, 1972—Dr. Stedman is a physical chemist educated at Cambridge and East Anglia in England, and recently employed as Senior Research Scientist by the Ford Motor Company. After a year on campus as Visiting Professor he was given a faculty appointment. He teaches courses on the kinetics of gases and the analysis of components of the atmosphere. He has brought together a group in atmospheric chemistry and has substantial research funding, including most recently work on the anticipated effects of space shuttle launches.

George F. Estabrook—Assistant Professor of Botany, 1971—Dr. Estabrook is a specialist in the application of mathematical and computer techniques to biological and ecological problems. He was brought to the campus in 1970-71 from the University of Colorado with grant funds, but his continuing appointment did not involve further grant support.

The rugged beauty of the Wasatch Front is a valuable natural resource. Its management is of great concern to Rocky Mountain region citizens. Below: Water resource limitations are a critical factor in growth and development of western resources. In this region, natural forces often shape the environment in dramatic fashion.

THE ENVIRONMENT AND MAN PROGRAM at the UTAH STATE UNIVERSITY

Dr. Cyrus M. McKell
Director, Environment and Man Program

A three-year grant by the Rockefeller Foundation to Utah State University effective January 1, 1971, funded the university-wide Environment and Man Program. The program provided the faculty, staff, and student body with an interdisciplinary research and educational opportunity to study environmental problems in Utah and the Rocky Mountain Region with experts from outside the university.

A program director was selected by the Dean's Council. To advise the director on policy matters, a Steering Committee, consisting of faculty members and students from various colleges and disciplines, was also established. Selection of colloquia topics, program thrusts, and guidelines for research and program efforts were the major responsibility of the policy body. Later, additional staff were added on a part-time basis to implement program policies and activities.

The program developed processes to stimulate university-wide interdisciplinary cooperation, especially between the social sciences, humanities, and natural sciences. Major environmentally-related problem areas were examined in interdisciplinary colloquia, consisting of USU faculty and students and experts from outside the university.

THE PROGRAM AT USU

The broad purposes of colloquia were: to critically examine all aspects of the designated problem area, especially in its relationship to the Rocky Mountain Region; to determine the state of knowledge in the problem area; to identify aspects of the problem area in which knowledge was inadequate; to make recommendations for further research studies, and for public service and educational programs; to provide opportunities for university staff and students to meet and interact with state and federal agency officials, elected officials, and concerned citizens regarding environmental problems; and to select specifically those areas needing further research, public service, or education for which Utah State University had the present or potential capability to undertake and to formulate plans for follow-up activities.

The planning and implementation of colloquia were directed by interdisciplinary task forces. Specific educational, research, or public service activities based on recommendations of colloquia were also carried out by appropriate task forces. All activities of the task forces were designed to coordinate with ongoing university programs.

Increased university-community cooperation was a major goal. Efforts were made to stimulate university research, education, and public service needed by various groups in the state and regional community—especially local, state, and federal government entities—who were either significantly affected by program efforts or who were potential users of research findings.

The university was not adequately staffed in some areas of the social sciences, humanities, and education for effective interdisciplinary participation. Support for two full-time faculty members was provided for the purpose of developing greater strength in these areas.

ADMINISTRATION

A committee of Deans selected Dr. Cyrus M. McKell, Range Science Department Head, as program director. To advise in program development and provide liaison between the program and college deans and university staff and students, a Steering Committee of fourteen members was appointed. The faculty members were appointed on the basis of individual interest and university-wide representation. Student members were selected on their letters of interest and potential for contributing to program objectives. Meetings were held every two weeks except during the summer. Two extended planning workshops were held by the Steering Committee to define broad program objectives.

Major program activities were assigned to interdisciplinary task forces: planning of colloquia, follow-through activities, and research proposal development. As the program progressed a need developed for additional part-time staff assistance. A. Berry Crawford, Associate Head and Associate Professor of Philosophy, was appointed to direct and coordinate task force research activities. Donnie H. Grimsley, an attorney and Assistant Professor in the College of Natural Resources, was assigned to stimulate student involvement and to coordinate efforts involving groups in the community.

PROGRAMS DEVELOPED TO STIMULATE INTERDISCIPLINARY FACULTY AND STUDENT INVOLVEMENT

Colloquia

Under the direction of interdisciplinary task forces, five major colloquia were held on the following problem areas confronting the Rocky Mountain Region: Land Use Planning, Policy Formulation in Energy Resources Development, Human Values as related to Energy Consumption, Environmental Management in the Colorado River Basin, and Solid Waste Management. A number of specialized seminars were also sponsored such as: Solid Waste Management, Silviculture for Improving Environmental Quality in Communities and Recreation Areas, Environmental Law, Environmental Education, and the National Environmental Protection Act. The colloquia served as an effective vehicle for group analysis of problems. Each colloquium attempted to analyze thoroughly the issue under consideration, determine the existing knowledge base, identify areas needing more research and study, and make recommendations for further research or action. Task Forces determined those research and program areas which Utah State University had the capability to undertake or where the capability could be developed. These resulted in specific research, educational, and public service efforts. Through the involvement and contacts with national, state, and local participants in the colloquia important long-term benefits are expected to result.

Research

1. Competitive Mini-Grant Program

Research as a means of stimulating the involvement of faculty and students has been a major focus of the program. Competitive research grants totaling $40,000 annually have been awarded. Of the 163 proposals which were submitted over a three-year period, 42 were selected for funding. These grants ranged from $1,500 for undergraduates to $5,000 for faculty. Criteria used in selecting proposals were: the proposed research should provide an environmental value to society and be consistent with the mission of the university; the research proposed should have an interdisciplinary approach; the project leaders should define a receptive audience for the research and furnish letters of support from community leaders or agency officials who would cooperate and implement its findings; and the research could generate follow-up research proposals.

Proposals were reviewed by a designated group of faculty members and a student. Based upon recommendations of the reviewers, the Steering Committee selected the proposals to be funded. Generally, one year was funded for research.

2. Grants Made on Application

Two major grants were awarded by the Steering Committee on application. A grant for $24,120 funded the development of a statistical survey meth-

odology for determining public opinion on environmental problems confronting Utah. This project was directed by faculty members from the Department of Sociology with staff members from other disciplines serving as consultants.

An initial effort to develop a model of the Great Salt Lake received $10,000. Directed by the Utah Water Research Laboratory located at USU, this effort has received subsequent funding by the Office of Water Research.

3. Research Proposal Preparation Support

Assistance was provided for the preparation of research proposals for external funding. These efforts resulted in a $50,000 grant from the Environmental Protection Agency to assess the usefulness of the concept of carrying capacity as a tool in comprehensive regional planning. A follow-up grant of $100,000 to Utah State University and the Office of the State Planning Coordinator has been approved by the Environmental Protection Agency. The National Science Foundation provided $30,000 for a three-week workshop on Inadvertent Weather Modification. The National Endowment for the Humanities awarded the College of Humanities, Arts, and Social Sciences $150,000 for a four-year teaching program on human values. The Utah Department of Community Affairs provided a matching grant of $7,500 to conduct regional workshops in land use planning. Other proposals have been submitted for funding and many more are in preparation.

Staff Support

As suggested in the proposal to The Rockefeller Foundation, budgetary support was extended to the social sciences, humanities, and education as a means of strengthening the participation of those disciplines in interdisciplinary efforts. Staff support was primarily given to Political Science and Sociology faculty, secondarily to the Colleges of Natural Resources and Engineering. Staff receiving a portion of their support from the program changed as task force activities and the program's requirements changed. Support was also given to staff members involved in special short-term projects under task force direction.

Programs to Involve Undergraduate Students

Several programs were established for achieving a meaningful involvement of undergraduate students during the course of the program. Undergraduates participated minimally in the competitive mini-grant research awards. Since only eight proposals were selected for funding, additional programs were developed to better respond to the undergraduate needs and interests. One of these, an Environmental Action Grant Program, provided small amounts of funds to undergraduates or groups of undergraduates on the basis of a brief application. A panel of two faculty members and two students reviewed applications and recommended awards.

An Environmental Internship Program provided for constructive environmentally-related work experience for ten junior and senior students during the summer of 1973 in government agencies or other organizations dealing with environmental problems.

The Environmental Studies Program, a multidisciplinary curriculum leading to a Bachelor's degree, was approved by the Utah State Higher Board of Education in 1972. The Environment and Man Program helped to develop this degree program which now has nearly fifty students.

To increase the awareness of the natural environment among students, the Environment and Man Program cooperated in the initiation of the Outdoor Program with the Associated Students. The Outdoor Program rents equipment and provides programs affording students opportunities to enjoy and learn about the natural environment. Interest in the program has been sufficient to generate funds to the degree that it is now self-supporting.

Education and Public Service Efforts

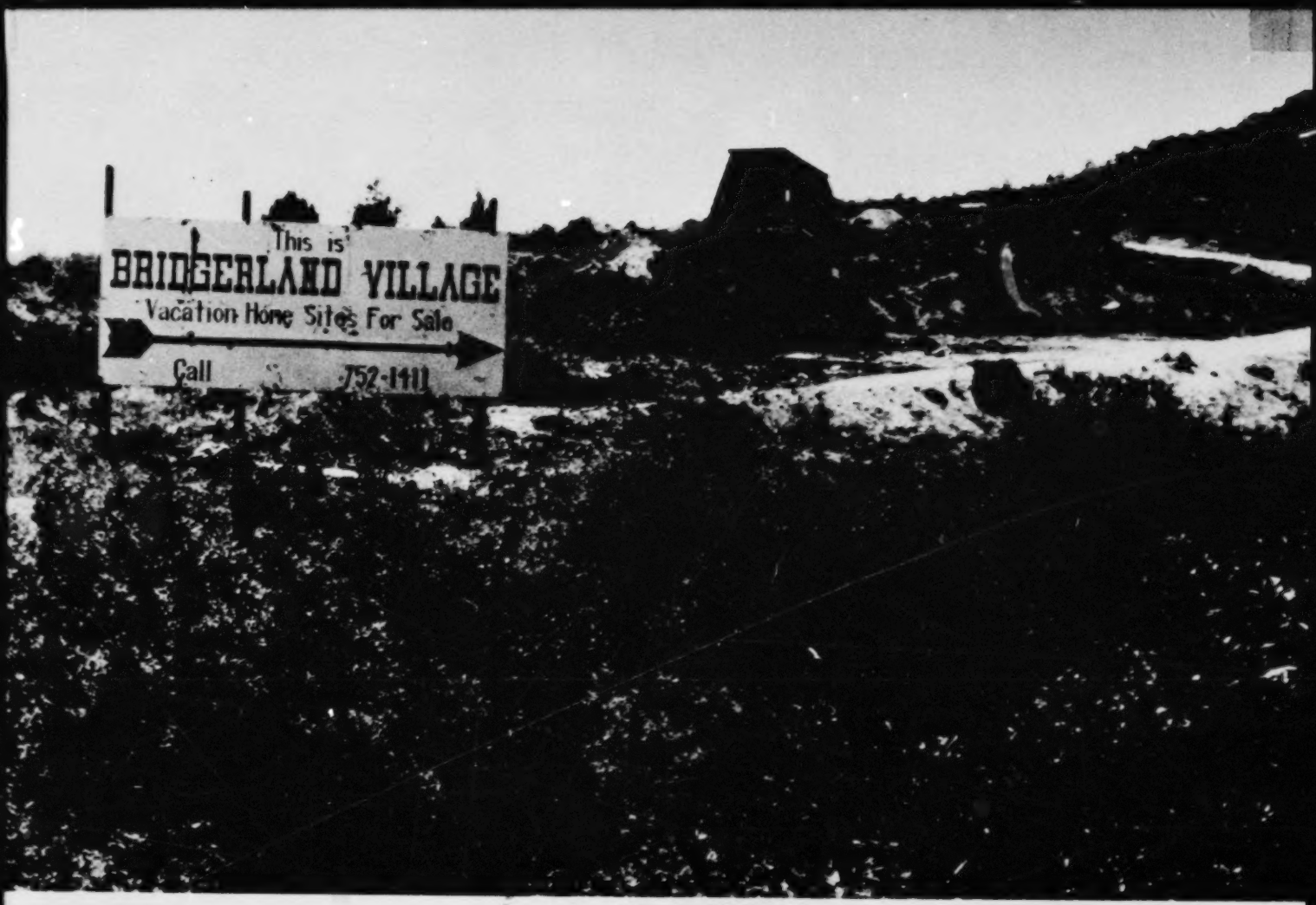
In addition to the public service and educational opportunities provided through research, colloquia and student programs, special educational projects were co-sponsored by the program and the university Extension Service.

LAND USE PLANNING

The program's activities in its most intensive task force, Land Use Planning, illustrate how colloquia, research, and community service were integrated into a major program thrust. These efforts significantly aided in the passage of new land use planning legislation by the State of Utah that had failed to pass in the previous two years.

Land Use Planning Colloquium

Land use was the first major environmental problem area to be selected for study by the Environment and Man Program. A colloquium on land use planning was held during the fall of 1971 under the task force chairmanship of Dean Thadis Box.



Developmental pressure in the intermountain region is increasing, often without adequate public planning and control.

The colloquium had several objectives: to document the nature of land use problems in Utah and the Rocky Mountain Region; to develop principles and practices for proper land use planning in Utah; and to inform elected officials and the public throughout the state on the nature of land use problems and possible methods to resolve them.

Land Use Studies

One of the most serious land use problems in Utah as well as the entire Rocky Mountain Region is the rapid development of recreational second-home subdivisions in unincorporated areas. Two major mini-grant studies of this problem were initiated by graduate students under the direction of qualified faculty. Donald MacPherson, a land economics graduate student, studied the impact of recreational second-home subdivisions to determine the external costs to local government. James Thompson, a graduate student in business administration, conducted a case study of a subdivision to determine the external costs to local government when subdivisions are developed in unincorporated areas of a county.

The program assisted the Bureau of Community Development at the University of Utah in publishing a detailed report of subdivision activity in nine Utah counties. The report pointed out critical problems faced by some small rural Utah counties caused by an increasing demand for public services by recreational subdivision owners. One small and sparsely populated Utah county has had forty-three subdivisions platted since 1962 and over 100 miles of roads have been dedicated to public use, although the county cannot afford to accept the dedication.

A number of activities have been undertaken to establish principles and practices for land use. "Retention of Open Space Between Gateway Communities" is the name of a study conducted by a landscape architecture student, M. J. Paulson. Using the Logan-Smithfield highways as the research area, the study, jointly funded by both cities and the county, has been a powerful tool for the Cache County planning commission. Governments in other areas of the nation have requested copies of the study report to use as a guide in coping with their own open space problems. Methodologies and considerations involved in establishing bicycle pathways, a study conducted by John Thompson, a graduate student in business administration, also resulted in a much sought after report.

Land Use Planning Workshops

Following the land use planning colloquium, a series of land use planning workshops were initiated throughout Utah. The workshops were designed to train local community leaders, both governmental and civic, in the fundamental considerations involved in wise land use planning. Matching funds to support the workshops were provided by the State Department of Community Affairs. Cooperating in sponsoring the workshops were the Utah State University Extension Service, the Utah Rural Development Committee, and the United States Soil Conservation Service.

An interdisciplinary task force met for two days in September 1972, to establish the focus of the workshops and to develop educational materials. A workbook was designed as an involvement-stimulator emphasizing two of the fundamental aspects of the land use planning process: establishment of community goals; and developing natural resources inventories and criteria for land use.

A companion publication, "The Heber Valley Story," related the successful efforts made in Wasatch County, Utah, to involve a broad spectrum of citizens in determining the county's problems, future goals, and policies.

Seven land use planning workshops were held—one in each of Utah's multi-county planning districts. Workshops were also staged for the State Legislature, the Bear Lake Bi-State Commission, and the Utah Environment Council.

Two months prior to a workshop, meetings were held with the executive director and chairman of each multi-county planning district and the relevant university extension coordinators. Several weeks later, the teaching team met with county commissioners and local government leaders. In these meetings, the purpose and scope of the workshops were discussed, and land use problems in their areas were identified.

Other Educational and Public Service Programs in Land Use Planning

Many educational efforts have been stimulated by the workshops. A program was developed with the State Board of Education to teach a unit on land use planning in a number of the state secondary schools during the 1973-74 school year. Under the direction of university faculty members, science and social science school curriculum advisers were

trained to develop teaching units in land use. An estimated 1,000 students were taught some of the basic ideas in land use planning during the 1973-74 school year.

At the request of Senator Carl Petterson, chairman of the Natural Resources Sub-Committee of the Utah State Legislature, Don Grimsley, attorney and assistant director of the Environment and Man Program, was temporarily assigned to work as adviser to that Sub-Committee to develop land use legislation.

Regional Land Use Activities

The Environment and Man Program stimulated a number of regional activities, primarily in land-use-related areas. The Environmental Studies Division of EPA funded a study to examine the usefulness of "carrying capacity" as a concept in comprehensive regional planning.

In October 1973, the Colorado River Basin Environmental Management Conference, organized by Berry Crawford and Dean F. Peterson, examined management and resource allocation problems in the Colorado River Basin. Approximately 150 policy makers and educators attended, representing state and federal agencies, regional federation, U.S. Congress, state legislatures, environmental research units, Mexico, business and industry, universities, and citizen groups. John Busterud, Council on Environmental Quality, headed the list of noted authorities who gave presentations.

The Environment and Man Program has been instrumental in stimulating the development of methodologies to measure attitudes in regard to land use and other environmental problems. A pilot study was made in southern Utah in 1971 under the direction of Stan Albrecht and Bruce Bylund of the Department of Sociology, to determine attitudes of the citizens in regard to coal-fired power plant siting in the area. Subsequently, major program support was provided to the Department of Sociology to develop a survey methodology to monitor environmental attitude changes in Utah. Public attitudes on land use planning were the subject of the initial study conducted in the fall of 1973. Results of this study were published and provided to the Legislative Council for distribution to the State Legislators just prior to the 1974 legislative session. Copies were also given to county commissioners and state officials. This study reportedly had a positive effect on the decision of the lawmakers to pass the land use legislation.

A CRITICAL ANALYSIS OF THE ENVIRONMENT AND MAN PROGRAM

Steering Committee

During the initial year, the Steering Committee advised on goals and policy by debating philosophical issues. The intense conflicts which were generated gave rise to innovative ideas, one of which was the values debate. After program directions were set and several key members (Gardner, Stokes, Steel, and Lyon) left the Steering Committee, little intense debate occurred. For the final year, the Steering Committee acted mainly as a reviewer of program administration recommendations. Should the role of the Steering Committee have been redefined?

Mini-Grants

Most of the mileage came from graduate students. This is probably because most were motivated to perform with excellence on a thesis project and because they were supervised by experienced professionals. Some projects were parallel with major program thrusts while others bore no relation. Should only those projects with a relationship have been funded in order to save money or was the stimulation in other areas worth it in terms of participation and graduate student training?

Several plausible reasons might be given for the lack of mini-grant response to undergraduate students: their relative lack of academic tools to perform research; inadequacy of supervision; and the general lack of incentives for undergraduates to perform research. Some staff members maintain that perhaps the internship program and the student action program offered a better opportunity for undergraduate participation.

Research Proposal Preparation

Although the preparation of proposals was not a major program goal, it was a logical extension of goals. We contributed the most to proposal preparation under two situations: when someone with an innovative idea convinced us of its value; and when one of our staff members found time to advance an idea. Failure of some projects to live up to our expectations was a disappointment, and a timely shift of funds to other staff members was difficult to accomplish since one-year commitments were usually made to departments. One or two of the departments receiving support apparently channeled the

additional funds to serve its own needs rather than to support the objectives of the Environment and Man Program.

Colloquia

The colloquia clearly had a major impact on creating over-all campus awareness and provided a new thrust to the university. Extensive new contacts and working relationships were created through the colloquia with persons outside the university. One disappointment was the lack of widespread faculty participation. We learned as we moved along who the real workers and innovators were.

Public Service

Best results in the area of public service came as a result of the commitment of full-time program and extension staff. We found it easier to attract public attention with timely topics such as energy utilization and land-use planning.

Energy Resources Conference

The most valuable part of this conference was the establishment of contacts throughout the region and the university's opportunity to take regional leadership on environmental problems related to energy supply and application. The conference impact on policy formation was negligible because government and industry were not involved in the conference. The lesson learned here is that you must actively involve those you desire to influence. This is probably the most significant lesson the university should learn from the Environment and Man Program. You cannot go it alone with programs of this magnitude and expect to make any impact on local, state, or federal policy.

Overall Impact on the University

There is no question that the Environment and Man Program has had a significant impact on the university. The university's image, already strong in natural resources, agriculture, water resources, and ecology, has been strengthened by the interdisciplinary approaches that have been brought to bear on these disciplines. How much and how long the impact will extend is hard to predict. Funding for a longer period would undoubtedly provide assurance of greater assimilation within the whole university fabric. Even so, the major programs in land use planning, energy resources decision making, values, and solid waste management are actively being continued.

WASTE MANAGEMENT

The colloquia on Waste Management, Regional Energy Resources Development, and Human Values and the Environment have had a similar, although lesser impact on university, state, and regional levels.

A major proposal on waste management was prepared in 1972 under the leadership of A. Berry Crawford and Dean F. Peterson. Although not funded, this proposal received a careful and lengthy review by the National Science Foundation.

More recently, the task force presented a proposal to the Environmental Protection Agency for a feasibility study of solid waste management in the rural six-county area of central Utah.

An interdisciplinary team of university faculty operating under a grant from the Environment and Man Program and additional funds from the Cache County Commission, developed a Solid Waste Collection and Disposal Program for the county. The program has been widely acclaimed and is now being implemented in the county. A series of workshops have been initiated in cooperation with the State of Utah Department of Health to stimulate similar programs in other rural Utah counties.

REGIONAL ENERGY RESOURCES DEVELOPMENT

Energy resources development is a regionwide problem, mostly because it rests upon a federal land use policy and a water allocation system that transcends parochial boundaries. Nonetheless, energy policy is fragmented and often proceeds ineffectively because of poor coordination among states, counties, private businesses, and federal government agencies.

Better coordination may be the key to better energy policies. It was felt that the program could perform this important function. The Environment and Man Program, therefore, worked with nine Intermountain universities to hold a conference on principles of energy resources development. A follow-up conference was immediately held, dealing with "Utah Problems of Energy Resources Development." Shortly thereafter an afternoon session of the Intermountain Section of the Geological Society in Laramie, Wyoming featured problems of strip mining to obtain energy resources in that state. The program jointly sponsored a conference with the Colorado School of Mines in December 1972, ana-

lyzing the energy resource problems of that state. A conference in Arizona is yet to be scheduled, but plans are underway for a program dealing with Arizona's energy resources. Over 300 copies each of the proceedings of the principal energy conference and of the follow-up Utah conference were prepared and distributed to industry leaders and government officials.

An Energy Task Force

As a result of the energy conference, an energy task force was set up and is currently seeking to develop research proposals and programs dealing with the energy policy problems. The work of the task force, directed by Edward H. Allen, Assistant Professor of Political Science, has concentrated upon two activities.

First, in the program area the task force is organizing energy crisis management workshops that will be presented to local officials. The task force has recently finished a first draft of a handbook to be used in these workshops. The handbook or some version of it may be distributed nationwide if current discussions with the Defense Civil Preparedness Agency come to fruition.

Second, in the area of research the task force has been involved in developing regionwide interest in energy policy coordination. The task force is aiding the organization of a regional research group under the auspices of the Institute of Ecology.

HUMAN VALUES AND ENVIRONMENT

Values are basic to all social interactions including activities that have immediate as well as indirect effects on the natural environment. The Values Task Force was established under the leadership of Jim Mulder of the Political Science Department to probe the types of issues and connections that relate values to natural environment. The overall objective of the task force was to investigate mechanisms and processes that could increase awareness in people concerning the meaning of their values and their effects on behavior as related to environmental issues. In addition, ideas were explored that could lead to the development of focusing research on specific aspects of the relationship between values and environment.

USU Values Parade

It was decided that the values program would be launched with a debate among well-known personalities, focusing on the conflicting values inherent in energy development and utilization and to be held in the USU Spectrum (Activity Center). This debate attracted approximately 2,500 people, one of the largest student-faculty audiences for this type of activity in the history of the university. The debaters explored the problem of human values and energy utilization from four different points of view. Introducing the debate was former Vice President for Research, D. W. Thorne. The moderator of the panel was John Baden of the Political Science Department. The debaters were: Milton Weilenmann, Director of Development Services for the State of Utah; Gary Snyder, an ecological poet and environmental activist; James Kilpatrick, a noted conservative syndicated columnist; and Dick Gregory, a well-known satirist, comedian, and spokesman for human rights.

James Kilpatrick was so impressed with the interaction and points of view expressed, as well as the student response and general university environmental awareness, that he featured the proceedings of the energy-values debate in his nationally syndicated column.

Follow-up Activities

As part of a follow-up strategy, a number of minidebates were conducted in each college of the university. These dealt with issues of specific interest to the colleges and featured public interest representatives, business representatives, other citizens from the community, and staff members. Among the topics considered were problems of economic development, wilderness areas, the role of engineers in environment-related projects, and environmental education.

It was felt that students attending the debates increased the level of their understanding of environmental issues, but that they did not gain an awareness of the relationship between values and environmental problems. Thus an ambitious program was undertaken to involve education, government, business, and religious leaders throughout the state in the examination of value problems. With the support of the governor, a workshop on family values was organized that was attended by leaders from various organizations and government departments. Two more workshops are planned — one dealing with educational values and another with environmental values. The objective of the workshops is to build support for programs that will increase public awareness of the significance of values to behavior relating to the family, education, and the natural environment. Implementing activities are now underway.

At the same time a number of faculty representing several disciplines worked on a proposal to establish an innovative educational program dealing with values and the total environment. The proposal, entitled "An Integrated Values and Human and Natural Environment Course Program," was submitted to the National Endowment for the Humanities; the Endowment made a major grant to the university to develop the program. The project will enhance the teaching of human values in several academic areas at Utah State University and has stimulated the involvement of disciplines that have heretofore shown relatively little concern for environment-related problems.

The Division of Environmental Studies has provided many opportunities for graduate student participation, including ecosystems analysis. Below: The Division is administered with the College of Agricultural and Environmental Sciences. Dean McCalla (right) assists Drs. Myrup and Matthews in program development.

6

THE DIVISION OF ENVIRONMENTAL STUDIES at the UNIVERSITY OF CALIFORNIA, DAVIS

Dean Robert A. Matthews
Associate Dean of Environmental Studies
and
Dr. Leonard O. Myrup
Chairman, Division of Environmental Studies

THE ROLE OF THE DIVISION

As an intercollege unit the Division of Environmental Studies is involved in undergraduate and graduate instruction, research and public service. The environment and its interaction with society is the broad subject matter area central to the interests and concerns of the core faculty and associates of the division. We view environmental problems and their solution as part of the total spectrum of the needs of society. Consequently, we feel that our primary goal is to assist in the reconciliation of the environmental, economic, social, and moral imperatives which face human society today.

The roles of the Division of Environmental Studies in the University of California include participation in a learning process that combines rigorous analysis of environmental problems, using the best available intellectual tools, with a broad perspective that recognizes the complexities, subtleties, and conflicts which are inherent in such problems. We intend that the results of the teaching and research activities associated with the Division of Environmental Studies be immediately useful in the decision-making processes in society. Therefore, we are seriously committed to the concept of "information delivery" to the extramural community as an essential part of the duties of the division faculty. We feel that this is necessary if society is to reach wise decisions about its environmental resources.

Serving as a Catalyst

The academic community as a whole at the University of California, Davis, possesses all the intellectual and physical resources to mount major efforts to solve many environmental problems. No one department, however, possesses expertise in all essential aspects of a given problem. We intend that the Division of Environmental Studies shall act as a catalyst to facilitate interdisciplinary and interdepartmental cooperation in working on major problems. Consequently, one of the goals of environmental studies is to broaden the existing scholarly disciplines and professions and encourage an interdisciplinary perspective in teaching and research rather than to create a new discipline. Thus, participating faculty need to be able to articulate a dual system of allegiances, which includes strong ties to an area of disciplinary or professional strength and also a career commitment to the broad perspective provided by environmental studies.

The Focus

The environmental programs at Davis have developed from a basic strength in the biological sciences. The popular discovery in 1970 of the word ecology was paralleled on the Davis campus by a desire of students, faculty, and administrators to broaden the science of ecology to include questions of public policy, geophysics, environmental management, and recreational behavior, as well as traditional biological topics. The problem of focusing and developing existing campus programs was seen to be as much institutional as intellectual. The relevant organizational models seemed to be, on the one hand, the discipline-oriented instruction and research departments in the natural sciences, and on the other, the traditional applications-oriented research departments of the Agricultural Experiment Station. The institutional problem was seen as one of developing an administrative framework that encouraged an interdisciplinary point of view, both in teaching and research, and which allowed for easy access to faculty and students on a campuswide basis. It was clear that strong support from both the faculty and administration was necessary.

Information Delivery

From the beginning, the function of "information delivery" was thought of as central to a strong environmental program. Clearly university excellence in teaching and research are an essential but only partial response to the problems of the environment. Therefore, an "environmental extension" component was a prominent part of early thinking at Davis. The existing models were the Agricultural Extension Service, historically serving the agricultural industry, and University Extension, which typically organized evening classes for general audiences. We felt at that time, and still do, that a new conception of public service was needed which encouraged faculty to interact with governmental and community decision-making at all levels.

Thus, in 1970 there was a happy coincidence between the emerging academic programs at Davis and elsewhere, and the aims and objectives of The Rockefeller Foundation.

THE STRUCTURE OF THE DIVISION

The formation of the Division of Environmental Studies (DES) was the most visible response at Davis to the rise of national concern for environmental problems. The division is a budgeted intercollege instruction and research unit which houses faculty, administers research space, and offers undergraduate instruction in environmental studies. The division is administered by an Associate Dean of Environmental Studies from the office of the Dean of Agricultural and Environmental Sciences. Neither a department nor a college, but an autonomous campuswide unit reporting directly to its own dean, the DES cuts across the boundaries of the six colleges and scores of departments at Davis. The arrangement facilitates drawing on the total expertise of the university.

Core Faculty

The core faculty of DES have appointments which are either completely in the division or are shared with a department. In addition to the core faculty, which amounts to approximately 13 appointments, the division collaborates with a larger group of faculty in teaching and research programs. Environmental studies courses taught by faculty outside of the division are arranged either by payment (in terms of academic salary) to the department in question, or by supplying faculty to teach courses in return, or by "philanthropy" on the part of departments in allowing faculty to teach outside of their academic domain. The majority of the youthful core faculty are assistant professors. The disciplinary backgrounds of the core faculty are now evenly divided among the biological, physical, and social sciences.

The Division of Environmental Studies has recently occupied a new building (actually a new wing of an existing building). The new space, which was specially designed to house an interdisciplinary faculty and to facilitate cooperative research and teaching, amounts to over 20,000 square feet. The facility will also house the administrative offices of the Graduate Group in Ecology and the Institute of Ecology.

Advisers

Two faculty groups advise the DES. The Environmental Program Coordinating Committee was charged by the Dean of Agricultural and Environmental Sciences, in 1972, with planning the overall direction of the teaching, research, and public service commitments of the campus on environmental questions. The Council for Advanced Study of the Environment functions more as a "think tank" in environmental education and research. It identifies environmental problems in their broadest contexts

and recommends how the resources of the university can best be brought to bear on them.

THE UNDERGRADUATE TEACHING PROGRAM

The twenty-four courses offered by the Division of Environmental Studies are designed to meet campuswide needs in specific academic areas. The environmental studies curriculum compliments and extends other campus programs and is not meant to be complete in itself. In most cases the courses form natural groupings or sequences which can serve as minor areas in many major programs.

For the purposes of this document it is convenient to separate the undergraduate curriculum into four broad subject matter areas. These are Ecology, Environmental Policy Analysis, Environmental Science, and Planning. We are presently in the process of expanding the offerings in Ecology and Planning, in each case with the objective of focusing the campus undergraduate program by setting up a coordinated group of courses which can serve as a minor in various major programs.

The division does not offer a formal major in environmental studies. This was a deliberate decision made after careful consideration of the pros and cons of such a program. As an end result, the factors which prevailed were: the feeling that sufficient opportunities for "environmental generalist" majors already existed at Davis and elsewhere; that an open, campuswide structure would be difficult to maintain if the division offered a series of focused majors perhaps leading to competition with existing programs; and that pressures on young faculty to develop research programs, participate in information delivery activities, and maintain disciplinary connections did not allow the time for the intense absorbing demands of building up a major. At the present time we are satisfied with this decision although several faculty are gaining experience in directing individual majors in specific subject matter areas and it is conceivable that these programs could be formalized in the future.

Team Teaching

An important feature of the undergraduate program has been the team-taught courses. The majority of environmental studies courses are taught by more than one instructor. We have found this to be an appropriate means of presenting the interdisciplinary material required by environmental problems. In addition, it has been an important mechanism by which faculty from various disciplinary backgrounds learn the points of view, intellectual tools, and major results of their colleagues' disciplines. We anticipate that team-taught courses will remain a central part of the program of the Division of Environmental Studies in the future.

RF Intern Program

The Rockefeller Intern Program, administered by the Division of Environmental Studies, is as most intern programs, designed to allow the student to apply his or her skills and background knowledge in meaningful decision-making processes. Interns in this program are already committed to the field of environmental studies and are generally upper division undergraduates with some area of expertise. They are not so much interested in trying to make a choice of career, but rather in exploring where and how they can apply their interest and concern with the environment and in having practical experience in their chosen career. In order to give them this experience, they are placed in positions which expose them to high level decision and policy making in private, governmental, and quasi-governmental agencies and organizations. The program has placed interns in state legislative committees, agencies, and departments concerned with environmental issues, local planning commissions and special interest committees, private consulting agencies and conservation or environmental-minded public interest groups.

The students are required to work 20 hours a week. In order to receive academic credit they are required to file a mid-term and final report and to attend regularly scheduled seminars. The purpose of the seminar sessions is to discuss any problems that crop up in their internships and more specifically any information or feedback on current environmental issues. These sessions are of great value in assessing the value of the internship program.

The value of the program as the interns evaluated it falls into three areas: concrete contact with the nonacademic world; an opportunity to evaluate themselves and their professional goals; and a chance to put meaningful impact into the real decision-making process.

GRADUATE PROGRAMS AND RESEARCH

Most members of the core faculty, by virtue of split appointments or other formal associations with disciplinary departments, have more than one option for the training of graduate students. All DES faculty, however, are members of the Graduate Group

in Ecology which offers an M.S. and Ph.D. in Ecology. The program of the graduate group is broadly conceived so that students with backgrounds in the physical and social sciences can be accommodated, although the basic strength of the group remains in the biological sciences.

Research programs supported by intramural and extramural funds (primarily the latter) include projects in the areas of aquatic ecology, environmental management, land-use planning, biophysical interactions in ecosystems, public policy analysis, and social behavior of animals. The individual projects are administered by the Institute of Ecology, a campuswide organized research unit which handles grant accounting and coordinates the use of research space in a 10,000 square foot laboratory on campus, and in off-campus laboratories at Castle Lake, California and at Lake Tahoe, California-Nevada. The largest single research project in which DES personnel participate is the Tahoe research program directed by Professor C. R. Goldman and supported by NSF-RANN. The Tahoe program includes basic work in aquatic and terrestrial ecology, study of political, administrative, and regulation processes in the Lake Tahoe Basin, and scholarly work on the historical basis for the present social climate at Lake Tahoe. The Rockefeller grant has had great beneficial impact on most of these programs through support of graduate students. The existence of Rockefeller Research Assistantships has allowed faculty throughout the campus to strengthen and expand new research programs. Faculty involved in research related to environmental quality have also been supported with individual grants from Rockefeller Foundation funds.

INFORMATION DELIVERY

Explicit commitment to the processes by which the results of university teaching and research are delivered to the community at large have been part of the DES concept from the beginning. Support from The Rockefeller Foundation has been particularly important in this area. As is appropriate to the multifaceted nature of the audience, many approaches have been used. (1) Student/faculty workshops (with academic credit) have been directed at specific community problems with, in many cases, participation of members of the community. (2) Faculty have conducted applied research projects in collaboration with state and county level governmental groups. (3) A successful student intern program has been set up with matching funds from The Rockefeller Foundation and other client groups. (4) Several joint programs have been carried out with the Cooperative Extension Service (two members of Cooperative Extension are now housed with DES) concerning such topics as the benefits and costs of community growth. (5) Short courses and conferences have been set up for specific agency personnel (such as the Bureau of Land Management) and for general audiences in cooperation with University Extension. (6) A cooperative environmental education program has been initiated at Lake Tahoe with the participation of nine colleges, universities, and public agencies. The Rockefeller grant has funded a program coordinator who is now merging into University Extension with a portion of an experimental faculty/extension position. Prospects appear good that this position will merge with the Cooperative Extension Service.

Workshops

Workshops of the DES are an important part of the information delivery programs. These are both on-campus formal courses and off-campus community-oriented courses and activities. Under funding of the Rockefeller grant, these workshops have played an important and significant role in the overall plan for the division. The workshop concept provides an excellent opportunity for a multidisciplinary approach to environmental issues. Within the Division of Environmental Studies, the workshops are divided into two general categories: on-campus formal courses and off-campus workshops. The on-campus formal workshop courses in environmental studies give the advanced undergraduate and graduate students and faculty the opportunity of concentrating and focusing on areas of environmental issues and application of methods for resolving these issues using multidisciplinary approaches. The teaching and research programs of the division and other departments on campus are strongly benefited by such workshops.

The off-campus workshops are designed for general audience participation in community-oriented environmental issues and for specific professional participation in community or regional issues. The workshops were organized and presented under the auspices of the Division of Environmental Studies and in direct cooperation with University Extension and the Agricultural Extension of the University of California. Both the DES and the extension components have stressed the interdepartmental and intercampus cooperation and participation in these workshops. Within extension workshop programs,

appropriate faculty from other campuses and universities as well as professionals from other institutions, public agencies, and the private sector have been involved.

The very diverse nature of these workshops has resulted in focusing on problem-solving approaches to environmental issues and providing the division with an opportunity to develop a multidisciplinary approach and interaction between involved students, faculty, and the community. Opportunities for both applied and basic research have developed and the teaching program of the DES has been a direct beneficiary of such activities. The community has also directly benefited by these outreach programs. The information delivery system aspect of this program has a very important dimension in bringing a variety of faculty and student-oriented research data to the community with direct application to environmental problems or issues faced by this community.

The on-campus courses in environmental studies will provide opportunities for advanced undergraduate students, graduate students, and faculty to comprehensively investigate specific areas of research for the resolution of environmental issues or problems. These programs have the added dimension of a multidisciplinary approach. The off-campus workshops are geared for general audience participation in a community or allow a faculty member to participate in a community-oriented program. This program allows for the additional input of the concerned community citizens.

The workshops are a major part of the outreach program of the Division of Environmental Studies and provide excellent opportunities for the generation and dissemination of applied and basic research. They also provide an opportunity for on-campus teaching techniques and methods to be presented to a larger or communitywide audience. These methods can be applied to help solve community-oriented environmental problems. In conjunction with a well developed information delivery system, the workshops provide an excellent way to present faculty research findings that relate to specific community identified environmental issues or problems.

PRESENT POLICY AND FUTURE DIRECTIONS

To look at the future extension of the present operational policy of the DES is to assess the long-term impact of the Rockefeller Foundation support on university policy. There are several main components of this assessment.

Teaching Policy

Faculty of the division participate in undergraduate and graduate teaching programs. At the undergraduate level, the primary objective is to support and complement existing major programs. We feel that society will need more well trained problem-solvers and managers who possess specific analytic skills *and* a broad perspective. Our conclusion is that it is better to broaden a civil engineering or sociology major with a set of environmental studies courses than to create a new generalist major. However, this posture does not preclude the formation of rigorous major programs in specific and important areas which are determined to be lacking on the campus. At the present time, faculty are encouraged to gain experience with environmental studies majors through the mechanism of individual majors.

The undergraduate curriculum may be conveniently described under three major categories.

Ecology and Environmental Science

Currently, our offerings in this area include courses on the principles of ecology, environmental science, oceanography, limnology, and energy and management-related material. The primary objective is to develop an ecology sequence, useful for a wide variety of majors, which relates closely to the appropriate environmental sciences and emphasizes management applications.

Human Ecology

Under this category we include our courses that deal with interaction between human culture and the environment. The perspective is primarily from the social sciences. The current offering includes courses on the environmental determinants of social processes, cultural ecology, environmental health, demography, and environmental perception. In this area, we aim to develop a curriculum that draws upon the social and natural sciences, as well as the humanities, to present a broad view of the phenomena of human culture.

Policy Analysis and Planning

Courses in this area concern the decision-making and policy-formation processes as they relate to environmental issues. We are particularly committed to developing a sequence of courses in resource and regional planning. Our objective is to develop a curriculum in this area that examines public policy and planning with full consideration given to the

constraints of ecology, economics, resource availability, and social amenity and equity.

We are particularly concerned that environmental problems are not presented as the exclusive prerogative of science and technology. It is important that the emphasis on values and the historical perspective provided by the humanities be included in the environmental studies curriculum. Therefore, we intend to work to develop courses in the humanities which relate to environmental concerns.

The Need for Innovations in Teaching

The Division of Environmental Studies has a substantial commitment to developing innovative methods of teaching. We intend to systematically investigate alternatives to the standard lecture system. These include workshops, problem-oriented courses, intern programs, use of gaming and simulation techniques in the classroom and other computer-based technologies, and televised courses.

At the graduate level, faculty of the division participate in training students in the Graduate Group in Ecology and several disciplinary or professional graduate programs. Inasmuch as the programs of the Graduate Group in Ecology are of particular importance to the DES, all faculty of the division are expected to participate in the teaching, advising, and administrative activities of the group. We plan to play a major role in developing graduate curricula for the programs of the Graduate Group in Ecology.

In addition to the Graduate Group in Ecology, we also see a special relationship with the new graduate program in administration on this campus. It seems appropriate to us that faculty of the division who are interested in public policy aspects of the environment should participate in a graduate program in administration. Therefore, we are ready to play a role in the development of aspects of this program that relate to environmental problems.

It is the division's policy that a standard teaching load for full-time faculty is three regularly scheduled classes. We recognize that team teaching is a highly effective means of presenting interdisciplinary material and that faculty who share a given course carry a larger load than the half course taught by each of two instructors. Therefore, our policy is that a course shared equally between two instructors shall be counted, for the purpose of teaching load calculations, as three-quarters of a course for each instructor. Teaching load credit for courses equally shared by more than two instructors shall be reckoned according to the same proportion.

The DES is strongly committed to excellence in teaching. Consequently, we feel that balanced, equitable, and dependable evaluation of teaching performance is essential. Teaching evaluation in the division will be carried out by two means: student evaluation to be done by means of a flexible system that is geared to the specific format of the class in question (lecture, lab, seminar, workshop, etc.); a faculty review system which will consist of teaching evaluations written by faculty of their team partners.

RESEARCH POLICY

The research programs of the division will be directed at significant problems of the environment of man. In any particular case these may be basic or applied, or may involve implementation of scholarly results in the public domain. We shall stress cooperative interdisciplinary research because most environmental problems require this approach. Our general strategy will be the scientific method as defined by P. W. Bridgeman, "Doing one's damnedest with one's mind, no holds barred."

We are committed to the principle that the results of university research should become part of the scholarly literature. In the highest and most honorable sense, research publications are the lifeblood of the community of scholars of which we are a part. Yet, publication does not necessarily mean a contribution to a disciplinary literature. We intend to play a role in the development of a new kind of interdisciplinary scholarly literature that includes a strong emphasis on application and implementation aspects.

The research activities of DES will be concentrated in three areas related to the teaching programs previously described.

Structure, Dynamics, and Management of Ecosystems

Research in this area is directed toward the discovery and clarification of basic ecological principles and their application in environmental management. Components of this program include basic processes (material and energy flow, community structure, population dynamics, and evolutionary processes), aquatic systems, animal behavior and communication, transport phenomena in the biosphere, interactions between physical and biological processes, and management strategies and policy implications. The primary objective is to encourage the development of ecology into a true predictive science that can provide guidance for understanding and management of the environment of man.

Human Ecosystem Analysis

This research program is directed toward the study of human culture relative to ecological processes. Components include the interaction between the environment and cultural evolution, environmental perception, and the general area of the quality of man's environment. Like the associated teaching program previously discussed, this research program focuses on human culture with a perspective broader than that provided by the social, biological, or physical sciences.

Resource Planning and Policy Analysis

Problems studied in this program include land-use planning, resource and environmental quality management, and political, social, and economic aspects of environmental policy. This research is primarily devoted to the study of the best means of developing and implementing effective public policy relative to resource allocation, land-use, and the management of environmental quality.

Research Goals

At present, the first and third programs receive the greatest emphasis in the division and we anticipate that this will remain the case in the future. However, we feel that in the long run, human ecology should be an important program and we plan to develop this area as rapidly as resources and cooperation with other campus units allow.

The research space associated with the research laboratories (Physical Planning, Computing, Human Ecology, Physics and Engineering, Electronics, Experimental Ecosystems, Chemistry and Aquatic Ecology) are our greatest physical assets. Their proper administration is a matter of considerable importance to the division and the campus. Inasmuch as the division has only recently occupied this space, it is not appropriate to set down detailed ground rules at this time. However, some general principles can be stated at this time: the research space should be primarily used for interdisciplinary research; every effort should be made to involve faculty from the disciplinary departments to participate with DES faculty in the use of the research space; policy for the use of each laboratory will be set by the chairman in consultation with a user group; and space assignments in the research laboratories will be made annually on the basis of the merit of specific projects and overall program priorities.

We anticipate that the Division of Environmental Studies will continue to cooperate closely with the Institute of Ecology. The institute's programs should be one of the chief means by which campuswide integration of the environmental research effort occurs. The development of such facilities as a Limnology Laboratory at Lake Tahoe, for instance, would increase the campuswide research effort at Lake Tahoe.

We plan on a gradually accelerating level of research support during the next five years. This will be necessary to develop the potential of the DES research space, to support the needs of developing research programs and to provide for new faculty.

Focus on Ecology . . .

We feel that ecology is the most important subject matter area to the research programs of the Division of Environmental Studies. Inasmuch as ecology provides the overall cohesion for almost all our research programs the indicated level of effort is not great. It is our judgment that campuswide, more strength is particularly needed in several branches of ecology. Therefore, we identify this area as requiring additional staffing in the near future. In particular, we feel that theoretical ecology should receive greater emphasis on this campus. It is apparent that the science of ecology is going through a period of great activity relative to its theoretical superstructure. It is not clear, however, whether any number of theoretical approaches have the force of general principles. In our opinion, ecology is at the point where the hard work of reconciling the best available body of theory with field observation is needed for scientific progress. Appropriate speciality areas include population dynamics, behavioral biology, ecological thermodynamics, and physiological ecology. We feel that the campus should have the objective of developing a critical mass in this area in the next five years. The appropriate cooperating campus unit seems to us to be the Division of Biological Sciences inasmuch as DES is associated with most of the appropriate disciplinary departments. Probably the majority of these appointments should be in DES, although we would propose to let the nature of the expertise of outstanding candidates and campus programmatic needs determine the details of any particular appointment.

. . . And Geophysics

Geophysics is also a high priority area in our estimation. It is apparent that transport and diffu-

sion phenomena in geophysical fluids (atmosphere, oceans, lakes, and rivers) are of overwhelming importance to many, if not most, ecosystems. Yet the research devoted to the interaction between geophysical fluids and ecosystems is extremely sparse. For instance, lakewide circulation patterns are critically important in determining exchange with the biologically active nearshore areas and upwelling, yet very little is known even at intensively studied lakes like Tahoe. In surveying the expertise available on campus in geology, atmospheric science and civil engineering, we feel that the technical speciality most lacking is numerical hydrodynamics. This is a highly developed field in meteorology and oceanography and its absence at Davis is an anomaly. Sophisticated wind-driven lake circulation models have been developed and could be applied at Tahoe and elsewhere. We feel that the mating of this powerful technique and ecology would be an important step forward for the campus. We would see this individual as being primarily an oceanographer or physical limnologist but the equations and associated numerical methods are also close to those used in meteorology. Therefore, we would see this as a position to be shared either with geology or the atmospheric science group, with the majority of the appointment in DES.

INFORMATION DELIVERY POLICY

We regard information delivery and interaction with the public policy formulation and decision-making processes in society as part of the legitimate duties of the DES faculty. Such activities should be regarded as professional and academic functions, strongly related to university research and teaching. All information delivery activities should be consistent with the division's academic plan and should act to further academic programs.

Extension

Extension personnel are full and valued members of the Division of Environmental Studies. As such they are expected to participate in the division's activities and share the burden of administrative duties. Extension personnel will take the lead in organizing and facilitating extension activities, which should reflect the division's academic programs.

Faculty members are expected to contribute their expertise to extension programs at a level consistent with the overall academic goals of the DES. Participation in extension programs will be a consideration in the advancement of faculty.

Conversely, participation in the academic affairs of the division will be a consideration in the review of extension personnel.

As the teaching process is one of the primary functions of the university, and one which is the exclusive responsibility of the academic faculty, some care is necessary in setting up extension teaching programs. The intent is not to discourage such activities but to ensure proper academic review. Toward this end, all extension teaching programs will always be planned and supervised by a faculty member or by an individual with fully equivalent qualifications.

FACULTY POLICY

In the future, most appointments will be made in close cooperation with an appropriate disciplinary or professional department. A variety of arrangements can be successful. Our experience to date indicates, that as a general rule, a 75/25 percent split, in a professional department or DES works best in that it is clear to all concerned where the primary allegiance lies. This policy is designed to accomplish the overall academic goals of the division and to protect and encourage the careers of the younger members. Whenever possible, all faculty should work at developing strong associations with departments or faculty groups outside the division.

At the present time our immediate priorities for future growth lie with the areas of theoretical ecology, resource geology and geophysics. On the longer time scale, we anticipate that additional faculty will be needed on this campus in the areas of planning and human ecology, as these developing programs mature.

The question of continuance of the DES programs can best be discussed by considering the university administration's concern for these programs: in times of steady state budget conditions the university has invested resources in the form of FTE, teaching and research facilities and administrative support for the programs of DES. Such commitments will continue upon cessation of the Rockefeller grant. In addition the faculty of DES have developed extramural funding for general research projects and prospects for continuation of such support are good.

7

FIFTEEN RECOMMENDATIONS FOR DEVELOPING ENVIRONMENTAL EDUCATION AND RESEARCH AT AMERICAN UNIVERSITIES

Dr. Roderick Nash
Professor of History and Environmental Studies
Chairman, Environmental Studies Program
University of California, Santa Barbara

The following recommendations distill the experience of the staff, consultants, and grant recipients of the Rockefeller Foundation in environmentally-oriented teaching and research. Many of these suggestions are relatively prosaic. They summarize what one would expect would be necessary to start any new program at an established university. But the special characteristics and needs of multidisciplinary, problem-oriented study of the environment are apparent in some of the following discussion.

Another introductory observation concerns the fact that the recommendations constitute an ideal. Particularly in view of the recent and almost omnipresent budgetary shortages in higher education, few universities could move positively in all of the following directions even if they so desired. Realism dictates regarding the recommendations together as a model to be used as far as possible. Independence is also called for in the way these broad principles are interpreted and implemented at a particular institution. Pragmatism is essential. The recommendations should be tooled to fit in a specific academic situation. Yet, the policies and practices detailed below are those best calculated to advance the study of the environment in a university context.

1. ESTABLISH A CONTINUITY OF TENURED FACULTY LEADERSHIP

The ideal leader for launching environmental studies is one who associates his own academic future with the program. His position should be secured by tenure; junior faculty frequently find involvement in environmental studies a liability given its controversial nature on the campus. Beyond tenure, the director should have the confidence of his faculty colleagues and the administration to the extent that he can plunge into the new endeavor without experiencing professional disadvantage. In other words, if an individual's successful association with environmental studies is not productive of reasonable promotions, he cannot be expected to sustain his interest.

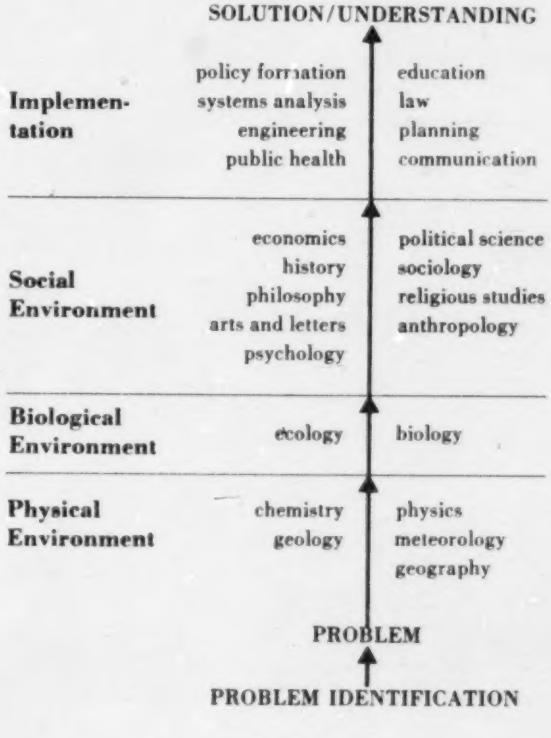
The director of the environmental unit should be a skillful academic diplomat. This ability, in turn, depends on the degree to which he is known and respected throughout the campus community. His research and teaching credentials should be impeccable. Environmental studies must not become a refuge for faculty (or students) who have failed in the traditional disciplines. The director's professional stature will always reflect the quality of his program. Excellence on the part of the director will lend the new program needed dignity and stature.

Continuous direction by one person for five period years is highly desirable. The identity of a new field and the skein of personal relationships that support it on a campus are not built in a day. Changing leaders in mid-stream almost always brings with it a change in emphasis as well as a new set of personal interfaces in the university community. After the environmental unit is established (five years appears to be the average time required) it can easily weather, and may even benefit from, change in leadership.

Sabbatical leaves of key personnel can be disruptive at the beginning of a new program's existence. The optimum arrangement seems to find the leader taking his leave the third or fourth year after launching the new program and then returning for one or two more years of administration. In this way neither the program nor an individual's research suffers unreasonably.

2. REGARD PROGRAMS, IN BOTH TEACHING AND RESEARCH FUNCTIONS, AS INTERDISCIPLINARY PROCESSES RATHER THAN COMPETITION FOR THE TRADITIONAL DISCIPLINES

Diagrammatically, this philosophy of environmental studies might be expressed as follows:



The central assumption, above, is that environmental studies can best be thought of as an arrangement whereby many disciplines contribute to a problem-solving process. Environmental studies does not compete with or purport to substitute for a single discipline like chemistry, economics, or English. It is, rather, a way of bringing these and other appropriate disciplines into a new complementary alignment.

The Conductor

The role of the teacher-scholar of environmental studies is comparable to an orchestra conductor. He serves as the catalytic arrow in the diagram. Insofar as an individual's professional competence permits, he may well contribute from the perspective of several disciplines. To resume the orchestra metaphor, he might be competent with several instruments. But the chances of his being a virtuoso with all of them are slight. Consequently he relies on the specialized expertise of colleagues.

Obviously the environmental teacher and researcher does not know all the answers to the immensely complex problems with which he deals. He should, however, know what questions to ask and of whom to ask them. His capacity for understanding the products and significance of disciplinary research should also be broad. The real forte of the environmental educator is synthesis. He is a specialist in generalization, and he must defend the rigor of this kind of breadth thinking against the criticisms of those who have traditionally associated difficulty with depth. Concerned as he is with a holistic approach to complex environmental problems, the practitioner of environmental studies deals constantly with disciplinary interrelationships. He functions, so to speak, as an ecologist of the academic community.

Exit the Renaissance Man

This philosophy has the great advantage of allaying the fear of traditional departments that they are in danger of being ignored or buried by a new environmental studies effort. On the contrary, it gives the disciplines a central role in the problem-solving process. The conception of environmental studies advanced here implies, moreover, that any faculty member involved must combine with his talent for synthesis a specialized skill in a traditional field. He will be qualified, in other words, by traditional university criteria. But he will also be prepared to take his place in both teaching and research as a member of an interdisciplinary team.

This theory of environmental studies deliberately downplays the renaissance-man dream with which some programs in the new field began. The idea of the do-everything environmentalist simply collapses before the complexity of modern knowledge. In its place rises the image of a group of scholars, united by a common concern, and contributing according to their several lights as part of a well orchestrated team. The problem orientation expressed in the diagram is taken up in Recommendation 8.

3. MAKE SUPPORT BY UNIVERSITY ADMINISTRATION A PREREQUISITE FOR STARTING PROGRAMS

The time to establish clear understandings with the administration regarding financial support and operational details is prior to beginning an environmental studies program. The bargaining position of faculty instigators will never be as strong again. The administration should be made to prove it really wants (will pay for) a first-rate operation. Mutual agreement to a written five-year development plan is one way of making sure that all parties fully understand what is at stake.

4. ENVIRONMENTAL STUDIES UNITS SHOULD BE CAMPUSWIDE AND AUTONOMOUS

Since the whole point of interdisciplinary environmental education is to transcend department and even college lines, it is important that it be authorized to operate on a campuswide basis. This entails the presence of a dean or other central administrator to whom the program director reports directly. There are many liabilities to locating environmental studies in a single department (geography or biology, for instance) and even in a single college. Environmental studies should have the ability to draw faculty talent from all relevant parts of the university. The presence of a dean of environmental or interdisciplinary studies also facilitates the program's achievement of autonomy which is vital to its separate, long-term existence. Involved is the ability of the environmental unit to be a full-fledged participant in the decision-making process of the university, with regard to faculty appointments and promotion, curriculum development (course initiation), degree requirements, and teaching techniques. Without such autonomy environmental studies will be severely handicapped in a university.

The need for a universitywide stance suggests that the environmental studies endeavor might best be classified within the university not as a "department" or "college" or "school," but as a "division," "institute," or simply a "program."

5. CREATE A CORE FACULTY BY MAKING FULL-TIME PROFESSIONAL APPOINTMENTS

Full-time appointments, particularly at the tenure level, express a commitment to environmental studies that anchors the program in the eyes of both students, *other faculty, and* administrators. The faculty holding such appointments logically assume responsibility for establishing and directing environmentally-oriented teaching and research programs. The presence of a nonfaculty executive officer or administrative assistant can be invaluable but is not alone sufficient to establish a firm program.

Review and promotion of core faculty should proceed according to clear standards based on the philosophy of environmental studies (see Recommendation 2). Review committees should be interdisciplinary, but a senior member of the faculty core should sit on all committees reviewing junior core personnel. Special protection from faculty hostile to environmental studies must be afforded core faculty by reviewing agencies and administrators.

Imperial Threats

While a faculty core is desirable its limitations should be recognized. Especially threatening to the role of environmental studies as a campus catalyst is the transformation of the core group into an empire that works to exclude rather than include noncore faculty. The core should always be supplemented with part-time faculty participants (see Recommendation 6) from the traditional departments.

Whenever possible core faculty should be housed under one roof. Office space should also be available for part-time faculty. The physical separation of disciplines on a campus is a major factor in their hitherto unimpressive record of collaboration.

6. PART-TIME APPOINTMENTS SHOULD BE MADE WITH A CLEAR UNDERSTANDING OF RESPONSIBILITIES AND ULTIMATE COMMITMENTS

Part-time appointments affirm the role of environmental studies as an orchestrator of faculty talent (see Recommendation 2). But arrangements that split a person's allegiance on a 50%-50% basis should be avoided. A better system is to structure the

appointments so that 75% of an individual's time is associated with one entity and 25% with the other. In this way a faculty member has a clear sense of where his academic "home" is located and impasses over promotion are minimized. Naturally faculty associated only part-time with environmental studies can not be expected to play a major role in student counseling, curriculum development, and program administration. These are tasks for the core faculty (see Recommendation 5). Indeed it would be rare for a part-time person even to have his office in the space assigned for environmental studies. But the contributions of part-time people to teaching and research teams is what gives environmental studies its interdisciplinary flavor.

7. AVOID VOLUNTARISM

To gain respect and assure continuity in an academic environment, environmental studies must pay its own way from the beginning. Consequently, it must achieve regular financial support from the university sufficient to carry the complete program. Alternatives that depend upon the good will of departments or faculty are normally doomed to failure after the initial burst of altruism passes.

Entailed in this recommendation is the policy of making environmental studies courses part of the regular teaching load of participating faculty. It means footing full bills for laboratories, field trips, secretarial help, and other expenses. Implicit, too, is the assumption that the university should not rely on extramural funding to meet the annual baseline needs of the environmental studies program. Outside grants are useful to support research, to initiate experimental courses, and even to provide start-up money for the program as a whole. But its expenses should eventually be figured into the general operating budget as part of the declared commitment of the institution. When extramural funds are used to finance part of the instructional program or hire faculty or staff, there should be a clear understanding with the administration that such support is of the short-term, seed-money variety and that normalization by the university will be forthcoming.

8. ORIENT MOST OF THE TEACHING AND RESEARCH AROUND ACTUAL ENVIRONMENTAL PROBLEMS

Problem study which emphasizes the indivisibility of the environment is an excellent way to build the interdisciplinary approach characteristic of environmental studies (see Recommendation 2), and to express the service-orientation of the program (see Recommendation 14). Broad problems, especially those that concern the region in which the university is located, offer many advantages as containers for pooling and relating individual teaching and research efforts. But it is not enough to dispatch students or faculty for isolated work on a common problem. Constant interaction and the use of a systems approach such as that discussed in Chapter VIII are essential. Particularly important is the frequent coming together in regular seminars of the team members. Only in this way can there be a tight coupling of research activities and a final report that is truly a synthesis.

Analysis vs. Advocacy

In both teaching and research built around problems there is always the danger of mixing analysis with advocacy. The line between them is fine, and the university's role in this regard remains moot. As a general rule environmental problems should always be treated as learning devices by both faculty and students. Partisan involvement, in a political campaign for instance, might be the product of a problem study, but it should in most cases take place on an individual rather than an institutional basis. In its official role environmental studies programs should advise and counsel rather than plead a cause. While the enthusiasm that "causes" generate is a definite asset to learning, there is nothing that so quickly destroys the academic legitimacy of an environmental studies endeavor in the eyes of a university community as inappropriate activism. The university can rest content with discovering and communicating solutions to environmental problems, leaving their implementation to society as a whole.

9. THOROUGHLY INVENTORY EXISTING FACULTY INTEREST AND ESTABLISH THE BROADEST POSSIBLE BASE OF SUPPORT FOR THE PROGRAM

Although the grass often appears greener elsewhere, most major universities possess more than enough faculty talent for outstanding teaching and research programs in environmental studies. The problem is that many of the faculty members capable of contributing are either not known to the organizers or, for a variety of personal and professional reasons, excluded. It is symptomatic of the isolation of many scholars that on a single campus persons working on similar problems are not even aware of each other's existence. Needed is a mechan-

ism for effecting collaboration on environmental questions, and the need grows with the size of the institution.

An inventory of faculty interests should be among the first steps taken in an effort to establish an environmental unit. Regular screenings of new faculty maintain the currency of the initial inventory. A mailing may suffice in some instances, a meeting in others, and for some purposes there is no substitute for a series of small lunches and office visits. The director of the environmental unit should be prepared for the role of ambassador to the university. He might draw considerable assistance from a published statement of the philosophy, purpose, and needs of his program, supplemented by a periodic newsletter describing its functions. If the environmental unit is not well known on a campus, the fault is its own. Busy faculty, with rare exceptions, will not beat a path to the new unit's door; good public relations is an essential part of an environmental program's responsibilities.

All-campus colloquia and year-long lecture series on a common theme are excellent devices for an environmental studies program to use to attract faculty and student interest. Teaching and research programs can be structured around the themes underscored in such gatherings. Particularly if magnetic, nationally-known figures lead the colloquia, the result in terms of university recognition of environmental issues can certainly be very impressive and worthwhile.

Every environmental unit should endeavor to secure a broad base of faculty support from a diversity of disciplines. While a steering or executive committee might number only three or five persons, an advisory group could easily accommodate twenty-five. It would be unwise to burden advisers with the day-to-day details of the program. Their importance lies in the areas of program philosophy, long-term needs, and public relations.

Special danger lies in the tendency of environmental studies programs to splinter into factions. In many cases the division is over the degree of activism the program endorses (see Recommendation 8). The consequence is that able and enthusiastic people are alienated, and environmental studies is the poorer. The field can benefit from internal differences of opinion provided they do not spill over into personal rancor. The director of the program should take every precaution against exclusiveness. No qualified faculty member should be denied the chance to help build the program.

10. ESTABLISH AN INTERDISCIPLINARY "PRESIDENT'S SEMINAR" FOR SELECTED FACULTY

A regular seminar in environmental problems involving faculty from several disciplines is a seedbed for environmentally-oriented research and teaching projects. The key to success in this endeavor is to make faculty participation a formal commitment just like teaching a course. One way to secure such a commitment is to compensate the participants by reducing their teaching load one course. Formal papers, the product of interdisciplinary collaboration, should be required. If the seminar is sponsored by the president of the university, and if its work is well publicized, participation can be made prestigious and coveted. An on-going seminar could feed a steady stream of enthusiastic, well-equipped faculty to the environmental studies program.

11. MAKE A SPECIAL EFFORT TO INVOLVE THE HUMANITIES AND SOCIAL SCIENCES IN ENVIRONMENTAL TEACHING AND RESEARCH

"Environmental *studies*" must not be transformed into "environmental *sciences*" but frequently is in fact, if not always in name. The sciences, for one thing, have an obvious relation to the natural and physical environment, and scientists are more familiar with collaborative teamwork than faculty of other disciplines. It is the rare environmental unit that is not led, if not dominated, by scientists. But the problems environmental studies should ultimately address are those that involve human values, attitudes, and policy. Man is at the root of most environmental problems, and the study of man is precisely the subject of humanists and social scientists.

Melding these scholars with their scientific colleagues is difficult. The intellectual and emotional gulf between what C. P. Snow called the "two cultures" is enormous. Not only indifference is involved but positive suspicion. To build a true interdisciplinary approach it is necessary to promote frequent intellectual and social interaction. Focusing on an actual environmental problem (see Recommendation 8) is useful since its solution will usually involve input from a wide variety of scientific and non-scientific disciplines. Respect for what other disciplines can contribute will follow from such interaction.

A co-directorship for an environmental unit is a

useful way of institutionalizing the commitment to bridging gaps between the humanistic and scientific orientations.

12. CREATE NEW COURSES IN ENVIRONMENTAL STUDIES

It is easy to create an "instant" environmental curriculum by going through a university catalog and listing all the courses that have anything to do with the environment. But the resulting smorgasbord does not reflect the methods and the goals of environmental studies. At all levels, from freshman to graduate, there is a need to reconceive and restructure course offerings. An environmental studies unit should have the power to propose courses as part of its autonomy (see Recommendation 4), and these courses should be problem-oriented (see Recommendation 8) and interdisciplinary (see Recommendation 2).

Pitfalls of Team Teaching

Team teaching is an obvious response to the last imperative. But there are serious liabilities to this instructional method that only the most careful organization can surmount. Unless all members of the teaching team attend all the classes, redundancy and discontinuity result. Indeed some of the most successful team teaching finds all the members of the team interacting together in front of a class. Less desirable, but more realistic in view of faculty time pressure and administration reluctance to "pay" three or five faculty members for the same course, is an arrangement where a coordinator attempts to integrate a series of guest lecturers. Thorough briefing of the visitors is obviously essential if the "vaudeville" is to succeed.

Given the difficulties of attaining excellence in team teaching, environmental instruction programs may wish to reconsider the merits of a single professor. Especially at the undergraduate level, a good teacher who is willing to work hard and is not afraid to admit his ignorance can succeed at interdisciplinary analysis. The addition of teaching assistants from various disciplines to such a course can be extremely helpful.

While new courses are needed, an environmental program should not pass by opportunities to help introduce environmental themes into established courses. The program should welcome, rather than resent, the offering of courses in the environmental field by traditional departments. Cross-listing such courses can be a useful catalog device.

At the graduate level an environmental studies program can function most successfully as a catalyst for interdisciplinary research teams. The specialized, depth learning normally associated with graduate education seems better left to the traditional departments. Thus an M.A. or Ph.D. in environmental studies would be improbable. One exception might be professional degree training in the use of the environmental impact statement. Here the generalist approach is quite germaine as a coordinating mechanism for the inputs of specialists.

13. ESTABLISH AN UNDERGRADUATE MAJOR IN ENVIRONMENTAL STUDIES

Courses and majors are the sources of ongoing academic vitality. Professors leave and research grants expire, but a popular major is as permanent as any part of a university. Undergraduates, moreover, lend vigor to a program, are capable under careful direction of performing significant problem-oriented research, and constitute a valuable source of leverage with the administration and the public. The undergraduate level is the easiest place to begin interdisciplinary teaching. It may also be the most important place because modes of thinking established early tend to have lasting influence. An undergraduate major in environmental studies, for example, is excellent preparation for students who later attend professional schools in law, business, education, and journalism. It is the last chance for those moving into graduate work in the arts and sciences to approach environmental topics in a general, holistic manner. Such experience frequently influences the choice of dissertation topics and careers. Environmental studies, moreover, seems to be one of the best themes around which to build the college education of citizens, consumers, voters, property owners, and parents.

There are, of course, limitations to an undergraduate major in this field. Due to its interdisciplinary nature, the major is seldom by itself sufficient preparation for admittance to graduate school, especially in the hard sciences. Students desiring to pursue this option should be advised early in their undergraduate years to take extra courses or even a double major. For some students it is preferable to think of environmental studies as a minor or just as an occasional course or two to fit in when their schedule permits. In this connection an environmental unit might work with the departments in arranging special courses as, for instance, in environmental engineering or environmental economics.

For the major itself, lower division grounding in the basic problems and the approaches to their solution is recommended. Finer tuning at the upper division should expose environmental studies majors to the approaches of as many of the disciplines as possible. The requirement that five courses be related to one discipline gives the student an opportunity to see the benefits of depth work and also to prepare for postgraduate options. An integrative senior project or thesis has much to recommend it as the capstone of a major. So do senior-year internships with off campus businesses and agencies that deal with environmental policy.

14. DEVELOP OPPORTUNITIES FOR COMMUNITY SERVICE

One of the reasons for introducing environmental teaching and research into higher education is to serve an obvious social need. It follows that environmental units should be constantly aware of appropriate ways to deliver information and ability to the general public. For some universities this will involve a considerable wrench in traditional methods of operation. Research monographs alone do not often solve problems. Faculty must find other ways of disseminating their expertise. Direct contact with legislative bodies, regulatory agencies, and private enterprise is more fruitful. So are workshops, short courses, extension classes, and slide-tape self-instructional modules. It must be understood that alerting the public to this or that environmental "crisis" is only the first step toward its solution. Professors and students can be leaders in this process if they think in terms of delivering as well as creating information.

A related need is for the systematic preservation of research results and their applications. The assistance of a librarian is badly needed in most environmental studies efforts. Also needed is the willingness to collaborate with other regional colleges and universities in advancing community service. The same interdisciplinary approach that organizes expertise within a university can be used to justify and promote interuniversity efforts.

15. EVALUATE ENVIRONMENTAL STUDIES REGULARLY AND FRANKLY

The fact that an academic program is new and innovative does not necessarily guarantee its quality. Frequently this is hard to discern. Even a poor environmental studies effort attracts the applause of those frustrated with traditional university procedures. Students will flock to anything that includes the word "environment." Such surface popularity should not be a reason to avoid full and frank evaluation of the quality of the research and teaching produced by the program. There should also be unblinking examination of the extent to which the program is actually meeting the most pressing needs of society in the environmental area. The change in leadership recommended after five years (see Recommendation 1) is an appropriate time for such review and, if necessary, reform.

8

TOWARD PARADIGMS FOR ENVIRONMENTAL RESEARCH IN UNIVERSITIES

Dr. Raymond J. Nelson
Truman P. Handy Professor of Philosophy
Case Western Reserve University

ENTER THE SOCIAL ANALYST

There is a serious national need for the universities to produce scientists who can understand and attempt to solve the very complex problems of the environment and society facing the contemporary world. In the words of President John G. Kemeny of Dartmouth College, "We need a brand new professional. I would call him a social analyst. I am talking about men who specialize in being expert on complex systems as opposed to being expert in psychology, sociology, government, or economics, who combine the knowledge of the social sciences with mathematics and knowledge of the computer, capable of attack on complex systems wherever they arise."*

Environmental problems may be characterized in part by the necessity of employing many cooperating disciplines in their solution. Accordingly, university environment groups should not support purely disciplinary research or educational programs and, positively, should include in their programs "meta-research" efforts directed toward the development of paradigms for handling multidisciplinary, complex problems, the development of criteria of research evaluation, and procedures for taking values, human and otherwise, into account in environmental research. In other words, such groups should make their own *methodology* a research object by way of appropriate feedback and learning mechanisms.

MAJOR OBSTACLES TO ENVIRONMENTAL RESEARCH

Among the obstacles facing universities attempting to do research in complex environmental problem issues are the following.

1. Although a research effort such as one which would improve water quality in a given region demands cooperation from a number of disciplines (e.g., economics, chemical engineering, aquatic ecosystems), research teams tend to fragment themselves into what in the end amounts to disciplinary, "publishable" research long before the problem is solved.

2. Team fragmentation is in part explainable by the lack of agreement among team members on what the overall problem is.

3. It is further in part explainable by failure to identify a *client* for research results. (The clients of

* Intercollegiate Press Bulletins, *Vol. 35, No. 18 (December 14, 1970).*

the mathematician are other mathematicians and somewhat indirectly a physicist or economist; of a civil engineer—a city or corporation; the client of the water quality project is in some sense the public—but the public is made up of a lot of parts having conflicting interests and goals.)

4. Frequently the individuals in new, multidisciplinary groups involved in such fragmented efforts return *permanently* to their home disciplinary departments, thoroughly disenamored of complex environmental research.

5. Environmental research is in part *normative*. One is not interested only in predicting the quality of water in a region given certain industrial, agricultural, and domestic circumstances, but wants to improve quality up to some standard within certain cost limits. (A subproblem is, whose standard—the public's? the environmental researcher's? the sanitary engineer's? the economist's? the Health Department's?) The need to take a normative stand, and perhaps reconcile it with that of others, conflicts with the "objective" attitude of the so-called disciplinary sciences.

6. The research often has no built-in component to ensure the possibility of implementation. Thus, research culminates in a miscellany of reports which get shelved in departmental libraries.

7. Research team members are evaluated for promotion and tenure in terms of their productivity in the discipline of the home department. This discourages further participation in multidisciplinary environmental concerns and encourages generation of research not having much applicability to the environment. (E.g., a certain water quality model considered to be of great merit to other water quality experts and in particular to one's peers in the systems engineering department may be of little use as a submodel of an overall model that takes into account economic, political, hydrodynamical, etc., dimensions. This may be attributable to poor provision for coupling, too much complexity in terms of realistic computer cost levels, etc.)

8. As a curative to obstacles 1-6, above, the university tries contract research for some client who is interested in a special aspect of the overall problem (e.g., economic design of a tertiary treatment system). This restricts the problem mainly to one of sanitary engineering; it solves the normative (values) problem by simply adopting those of say, a contracting state agency; it also solves the implementation problem as the agency itself uses the tailor-made research output. The trouble is that such an approach leaves the original complex problem where it was—largely unsolved—and does not qualify as "university level" research.

THE ELUSIVE PARADIGM

I wish to advance the thesis that these eight problems arise because of a lack of a paradigm for environmental science—that no conception of *normal* environmental science has yet fully emerged, and that the sought-after paradigm is to be found in the so-called "systems approach." Since so many different things are meant by this locution, I will try to isolate a relevant concept of "system."

What a Systems Approach Is *Not*

- It is not the same as "multidisciplinary research" although frequently a necessary condition for a system approach is multidisciplinary cooperation. For example, an ecologist, an applied mathematician, and a computer simulation expert may "interact" with each other even to the extent of learning something and yet generate three independent, pairwise inconsistent models of, perhaps, algae growth in a certain lake zone.
- It is not "model building" only, although modeling is usually a necessary part of a systems approach. For example, a logic model of a digital computer may be completely adequate as a system on which to hang chip electronics and yet completely miss the required structural properties for a really efficient working executive system.
- It is not General Systems Theory in the sense of Bertalanffy, Laszlo, Ashby, Wiener, Kalman, or Mesarovic. Much less is it coterminous with systems metaphysics à la Whitehead. To my mind, general systems theory is, when it is scientifically legitimate, a branch of mathematics. The development of it is essential to the systems approach, but it is not all of it.
- It is not decision theory, group decision theory, utility theory or ethics, although it frequently involves ethical, decision, theoretic, etc., issues.

What It *Is*: A Method

Positively, the systems approach is a *method*. It is used in a variety of scientific fields and professional activities such as biology, ecology, and social science on the one hand, and engineering and management on the other. The best way to describe what is usually meant by a systems approach is to list the features which are common in all of these applications. Among the most characteristic features of the systems approach are the following.

• **The phenomenon or problem of interest is considered in as broad a context as possible and under the most realistic conditions. This means, first, that** in a description of the phenomenon one uses concepts from many disciplines, and second, that the phenomenon is not considered in isolation but that external effects are recognized, say, as disturbances. For example, in the study of lake pollution, one does not restrict attention to hydrodynamics and chemistry of the lake, but also takes into account economic, social, and organizational factors which contribute to the pollution; furthermore, one does not consider only the lake but the entire basin contributing to the pollution.

• There are goals (objectives) in reference to which the description and studies are made. It is in reference to these goals or purposes that the boundaries of the system of concern are determined. Explanations of the performance of the system are given with respect to the goals; that is, the explanations are functional. This does not imply, however, that causal accounts of the performance of the components making up the system are ignored.

• Descriptions in a systems approach are functional in another sense, to be distinguished from causal descriptions. In a systems approach the objects of study, or variables, are recognized insofar as they interact with each other, that they form a "system," rather than in terms of their interpretations within a discipline (physics, chemistry, economics, etc.). The conceptual basis is provided by the logic of information processing and decision making rather than by physical laws, chemical principles or the like. An example of a functional description would be that of the working of a program in a digital computer. A phenomenal description, on the other hand, would be in terms of the actual physical operating of the mechanical parts, storage elements such as cores, and switching elements such as transistors, within the digital computer.

• In the systems approach, the objective of developing a description is to investigate behavior and/or alternate courses of action. In view of the complexity, this almost invariably requires the use of computer simulation.

WHEN TO USE THE PARADIGM

The systems approach is used in two main areas of human activities: furthering the understanding of complex phenomena, the environment in which man lives—"systems science"; improving actions and procedures for influencing the environment—"systems engineering" and "systems management." Although the basic approach and conceptual foundation in both of these areas are the same, there are some variations in methodology. In the action-oriented area, there is an emphasis on methods for making the necessary changes, in particular the entire range of decision-making and optimization techniques. In the basic science area the emphasis is on representation of the complexity of structures and multiplicity of goals involved in the system under consideration. The so-called "large scale systems" are characterized precisely by the complexity of their structure and behavior.

TOWARD A SELF-CORRECTING PROCESS

In contrast to paradigmatic science (e.g., classical physics or molecular biology) the environmental science paradigm we seek is a kind of self-correcting *process.*

It is fairly easy to reel off the standard characterization of the systems approach in terms of the setting of *goals* and *objectives, modeling* a system that sets such goals noting the real physical, biological, social, etc., *constraints,* and designing decision procedures by way of *simulation* of action alternatives or "scenarios." But this framework, though vaguely all right, is poorly understood and at the present time has to be re-nailed together for each project that comes along.

It seems to me that what is needed is a "meta" systems approach, namely one wherein a research organization *learns* how to meaningfully approach large environmental problems via feedback information from the users of its research output. Such an organization will eventually develop its own *paradigms,* share and refine them in concert with other like-minded groups until a *"normal"* environmental science emerges. It won't be like biology or even ecology, since its subject matter will be (except for considerations of mathematical structure and computational effectiveness) its own problem solving process, not some new, interdisciplinary slice of reality.

The Practical Approach

Although I can think of fewer more practical issues in environmental research than the sort raised above, the discussion will no doubt seem to be too "philosophical." So to pin things down, steps toward the development of normal environmental science would seem to require some or all of the following characteristics.

59

1. Environmental research must begin with a definition of the requirements of the originator and user of the research yield. He may know less about what he needs than the university scientist does and may be confused or even inarticulate as regards his goals and values, but then a dialogue must be entered into that implicitly educates the client and resolves conflict as much as possible *before* the first data are collected or the first differential equation is written. There is no other way.

2. The research requires an *architect* or *orchestrator* who fits the disciplinary pieces together with one eye on implementation and another on design and redesign of a feedback loop so that the research machine may yield better output on the next round.

3. The research output should in part constitute a *decision tool*, preferably embedded in an interactive mode computer (presumably a time-sharing) system. Detailed descriptions of models can be published for the edification and delectation of other scientists. The *client* (assuming you have found him) probably couldn't care less.

4. Live research should be supplemented by ongoing theoretical work suggested by the project itself, especially in the realm of ethics and goal conflict, group decision theory, and *systems* modeling, i.e., coupling of chemical, ecological, political, etc., submodels into hierarchical, coherent, most often necessarily highly aggregated systems. (By "hierarchical" is meant: what dependent variables at one level—say the economic—are "exogenous" variables to another system—say, waste generation?)

The closest *existing* paradigm, to be taken as the first (or, better, zeroth) iterate in the learning process sketched above, is ordinary engineering practice. So the final practical admonition is:

5. Do not isolate environmental research from engineering.

COMMENTS ON "TOWARD PARADIGMS FOR ENVIRONMENTAL RESEARCH IN UNIVERSITIES"

DR. RICHARD SCHEIN
PENNSYLVANIA STATE UNIVERSITY

Professor Nelson, speaking of research, speaks wisely. What he proposes is happening but cannot really happen unless there is confidence of long-term support—certainly long enough for his reflexive feedback loops to function. This reminds me of the recent furor in Britain over the Rothschild report which would establish customer-contractor relationships for most or all government sponsored research (between the research councils and academic science). The report raised grave doubts about future support of basic "science for knowledge's sake" research which has no client. As I remarked to Nelson, his approach is Darwinian. As a biologist, I know nature to be the ultimate pragmatist (that is good which works) and have confidence that nature's method, budget, and lack of time urgency will solve nature's problems with mankind. Whether mankind will be included in the solution may demand more prescient action by men.

DR. A. GEOFFREY NORMAN
MICHIGAN STATE UNIVERSITY

Most of the points made in Professor Nelson's paper are well taken and not peculiar to environmental issues. In general, however, the university is a subcontractor and does not hold (and should not hold) the implementation responsibility. Frequently, the agency with that responsibility is not in fact free to move to implement. It is at this point that public and political realities become the constraints. There simply may not be enough money to carry out a desirable step. (Example—failure to appropriate or release enough funds for secondary sewage treatment by municipalities abutting Lake Erie.) In such situations, what does not get done is the determination as to where available funds would best be spent.

Returning, however, to environmental research in universities, we can easily recognize the strong field strength of the disciplinary departments, but there are administrative ways of neutralizing this by the recognition of stable research units, with some funding not dependent on contract revenue. This in practice means some kind of institute or center with a program not limited to a single sponsor, and a leader, fully acceptable to his disciplinary department, but not dependent on it for further professional advancement. Many of our difficulties with inter- or multidisciplinary research in universities are agency or sponsor generated. They do not want us to do what we may perceive should be done. Generally they exclude policy issues or the determination of priorities.

Understanding Phenomena

It has long been my conviction that the primary role which universities can and should play in many problem areas, not just environmental, is to seek understanding of phenomena, because with understanding comes the opportunity of the next step, control, alleviation, amelioration, prevention, or whatever. The research output is a decision tool. An interdisciplinary team, university based, may then develop the strategy. If there are technological aspects, these may be subject to test or to some optimization approach, but there is no way short of political activism, not usually acceptable in publicly supported institutions, to go much further toward implementation. Perhaps Tom Edmonson's role in the clean-up of Lake Washington at Seattle would be an example of successful activism, but I suspect that at the time there may have been voices in the university that thought this to be inappropriate.

DR. LEONARD O. MYRUP
UNIVERSITY OF CALIFORNIA, DAVIS

There are some major pieces of the puzzle missing from Professor Nelson's analysis. It seems very apparent to me that Nelson's prescription is set in isolation from any institutional considerations or con-

straints. The developmental steps which he outlines show no relationship to universities; what he proposes could just as well be done in a private R & D outfit. In fact, it would be much easier. Why then advocate this approach at the universities?

Can It Work for a University?

It seems to me that Nelson's "paradigm" which I like, shows no relationship with the *primary* function of the university: education. At the universities there must be a connection between teaching and research or, sooner or later, something suffers. The problem is that while such arguments sound good, in all the specific examples I can think of it doesn't seem to work. I think this may be because of the lack of the strong connection with teaching and, perhaps, lack of a long-term client relationship.

I have pondered why problem-oriented, client-related research has been so successful in meteorology and beneficial to the development of the science yet doesn't work as well elsewhere. I think the time factor is important. It took decades for the U.S. Weather Bureau to develop its data-gathering network. It took ten years for university scientists and government personnel, working together, to develop operational numerical weather forecasting models. Graduate student research was an important part of this process as was undergraduate instruction. I think for healthy university environmental research, the client relationship must be long term, and federal and state agencies should be the targets.

Finally, it is critically important that the university support/reward structure be favor of such environmental research. It seems very clear to me that such efforts go nowhere without strong support from *both* administration and faculty peer groups.

DEAN ROBERT A. MATTHEWS
UNIVERSITY OF CALIFORNIA, DAVIS

The philosophically oriented message presented by Professor Nelson projected a real life situation of great concern to those university units involved in environmental research programs. His eight itemized environmental and societal issues (pp. 57-58) outline very clearly the problems facing existing and proposed university programs. I will comment on them item by item.

1. This is indeed a major problem, however, several of our faculty in our division are full FTE* and not strongly tied in with a disciplinary department. Such research results are published in those few available environmental journals, other less discipline-oriented journals, and in professional journals. One problem of this procedure is the "yet to be acceptable" environmental journals (acceptability by peer groups involved in merits and promotions).

2. This is inherent to most team oriented research and unless some strong guidelines are presented to this multidisciplinary group, the problem will continue. However, those teams consisting of faculty from diverse disciplines represented in an organized environmental studies program group have less fragmentation as a result of lack of agreement.

3. Certainly, client identification is a significant problem and in many cases there is the added problem of problem identification. Even once the client has been identified, addressing the conflicting interest and goals raises even greater problems. A concept that generally runs against the grain of academic researchers is early input into problem definition and needs an interest of user (recipients of research).

4. Unsuccessful or nonpositive reception of results from multidisciplinary groups, especially of fragmentary nature, do generate the need to return to mother's bosom (department) or at least, there is a hesitancy to continue such methods of research. A simplistic answer is to tune in multidisciplinary groups to a true team effort and a redefinition of the reward system based on acceptance of this team effort by peer groups.

5. A most difficult but critical process is this development of a normative stand and reconciliation of conflicts of environmental science with the so-called disciplinary sciences. Objectivity in environmental science is and can be attained (but in many instances with great difficulty).

6. Professor Nelson's indication that *often* research has no built-in component to insure possibility implementation is not necessarily *the* situation. Such a component should or can be built into the research and as noted, if not built in, research often is "round filed" or gathers dust in libraries.

7. Such problems of merits, promotions, and tenure, based on departmental evaluations of research, will continue until these "evaluators" accept the concept that environmentally oriented research is solid and has the dimensions of good disciplinary research as well as a more "nebulous" or broad concern aspect of multidisciplinary orientation.

* *In the University of California system and elsewhere, an "FTE" or "Full-time equivalent" is one job or, in this case, one faculty position.*

8. Some interesting points here but I add the suggestion that university contracted research in a tertiary treatment plan for sewage can be broadened to try to "solve" a broader environmental problem other than economics of tertiary treatment and implementation problems faced by the contracting agency. The allegation that such research is not "university level" should be given critical review. If such research is undertaken strictly, to speak to the problem noted above, then Nelson is correct—but a broader viewpoint would include concern for air pollution (e.g. ammonia stripping), water conservation, energy consumption, land use (disposal system), and other such broader concerns. In other words, parameters set by the contracting agency need not be total parameters. I completely agree that the lack of development of an acceptable paradigm is real, and that a true *normal* environmental science will develop under the envelope of a "systems approach model" as defined by Nelson's eloquent five point description of the development of normal environmental science. Many of the philosophical ideas expressed in Nelson's paper and discussion are perceived by individuals here at UCD, and such concern exists that this approach (paradigm for environmental research) is a most important element. A hopeful solution will be the utilization of those well-developed ideas which include the mathematical and engineering inputs with socioeconomic–humanistic and physical–biological elements. Yet just the molding of these disciplines is a formidable task.

DR. CYRUS M. McKELL, DR. MAC McKEE
AND DR. BERRY CRAWFORD
UTAH STATE UNIVERSITY

A Critique of the Five-Point Paradigm

With regard to the specific five-point paradigm proposed by Professor Nelson (pp. 59-60) we would have the following comments.

1. In relation to point one, the statement that the originator and user of the research yield ". . . may know less about what he needs than the university scientist does . . . ," certainly deserves a word of caution. Academicians who believe they know what is best for the client and proceed to tell them how to run his business deserve the "ivory tower" image they are likely to get. In addition, dialogue between the researcher and the client is necessary for more than simple client education and conflict resolution. Proper dialogue (not to be confused with academic pontification) between the researcher and the client will facilitate client involvement in the project; client involvement is necessary if the research product is to be believable (i.e. believed by the client), and usable (i.e. used by the client).

2. In Nelson's second point, he makes the statement that "The research requires an *architect* who fits the disciplinary pieces together with one eye on implementation and another on design and re-design of a feedback loop so that the research machine may give better output on the next round." We would make the general comment that this architect must interact with a team and not work as a single individual or domineering leader. Each member of the team must challenge the assumptions, methods of inquiry, and perceptions of the other members of the team. Environmental research is more than "fitting the disciplinary pieces together."

3. As for Nelson's third point, we would ask if it is intended that the "decision tool" make decisions? While we do not think that this is the intent, if it were so, there would be very few planners and decision-makers who would wish to use it. Also with regard to the third point, we would point out that the statement "the client (assuming you have found him) probably couldn't care less" (about model details) runs counter to our experience at USU and to the experiences of other research teams. Planners and decision-makers *care very much* about the reliability of the methods utilized in the model (if not the methods themselves) in arriving at model predictions. In addition, decision-makers as a group are intelligent people who have an inherent mistrust of computers and of computer programmers. That mistrust will be overcome only when they have confidence in and a general knowledge of the workings of the model. They do not and will not trust a black box.

"A Single Best Paradigm"?

With regard to the general idea of an environmental research paradigm, we believe that the assumption that there is a single best research paradigm for universities is questionable. Since there are a variety of environmental programs requiring research, a safer assumption is that there is more than one paradigm for conducting research. To make the point, consider the following environmental problems:

What is the best strategy or set of strategies for reducing phosphorus pollution in Lake Erie?

What is the optimum site for the location of a 3,000 megawatt power plant on the Kaparowitz plateau?

Should Provo Bay near Provo, Utah be conserved as a bird refuge?

Which of five proposed highway corridors or alternatives between points X and Y is the most preferable?

What plants and methods should be utilized in the revegetation of strip-mined oil shale land in the Uintah Basin?

What is the capacity of the natural and human resources and the infrastructure resources of a given urbanized region to support given levels and kinds of productive activities?

What is the capacity of the environmental media in this region to facilitate this production?

We submit that there is no single research paradigm for addressing and providing solutions to these practical problems, unless it is that paradigm which is the forerunner of "ordinary engineering practice." The process of formulating objectives for a model, constructing the model, testing its performance against those objectives, and revising the model (perhaps many times) in light of its performance, is called "systems identification" by engineers; other researchers know it as "empirical science."

REJOINDER TO COMMENTS ON "TOWARD PARADIGMS FOR ENVIRONMENTAL RESEARCH IN UNIVERSITIES"

Dr. Raymond J. Nelson
Case Western Reserve University

Professor Schein's brief comment concerning the Darwinian character of client-oriented research is, I think, correct. The systems approach with the feedback loop added is certainly reminiscent of the pragmatists (especially Dewey and in a way, even Pierce) and hence owes much to Darwinian theory, although one must take care not to confuse evolution (adaption) with learning.

I agree with Professor Norman's emphasis on the study of phenomena for the sake of understanding. To me there can be no interdisciplinary or multidisciplinary collaboration without the existence of basic, pure disciplines. But this does not rule out multidisciplinary investigations, and the latter must not, to reiterate a point I made in the paper, support disciplinary programs as such. Plainly put, an environmental research group ought not to support pure research in mathematics or biology; on the other hand, I cannot imagine a successful group of this kind not containing or having ready access to mathematicians and biologists.

In my opinion, Professor Norman confuses implementation responsibility or "activism" (which does not belong to the university) with research oriented toward use. Even normative issues, which are not avoidable, can and no doubt should be handled from the standpoint of an adviser or counsellor, not an activist. But these issues, when they arise, must be met by the university team on pain of its research becoming irrelevant.

Professor Myrup's and Dean Matthews' comments appear to be in general agreement with my own ideas. Dean Matthews is correct in his objection to my remark that economic design of a tertiary sewage treatment system is not "university level" research. It certainly is a "university level" engineering design problem; what I intended to say is that it is no longer university level environmental research.

In my opinion, Professor Myrup is correct in underscoring the *primacy* of education, including education pertaining to the environment. I also agree that research must be strongly coupled with teaching at all levels, and would like to add a sixth point to the "paradigm": "6. Environmental research must never be separated from environmental education, both academic and extramural." I fail to see, however, why application of the systems approach to private research and development in any way precludes such an application to universities. Why not do both?

The comments of Professors McKell, McKee, and Crawford of Utah State University are extremely important. There is indeed a danger of the ivory tower academician telling a client how to run his business. And there is also the danger that a client doesn't understand his own problems. What is needed is precisely the kind of interaction between research group and client prescribed by McKell, McKee, and Crawford. Equally important are their comments on the research architect. He must be a working member of the team and not a dictator. There is, however, some confusion over the expression "decision tool." A decision tool does not make decisions any more than a hammer makes houses. A decision tool is most likely an interactive computer program and may contain means for "scenario analysis" and optimization procedures. It tells one what would happen if he were to choose such and such a course of action and may, in addition, aid in the choice of the best one. The question of a client's interest in a model depends on the model. In making the comment "they [the clients] couldn't care less," I had in mind technical models such as sets of differential equations. No doubt the Utah State professors are right in their view that many clients need and

perhaps want careful description and documentation of computer models and programs.

A final general comment on the systems approach as I described it. One of the comments is that it is not peculiar to environmental issues. Another is that it "doesn't seem to work." And yet another is that it is "empirical science." This variance shows how far we still are from anything like a "normal" environmental game that we all understand and play the same way. Nonetheless, interchanges like the above seem highly beneficial in advancing common understanding.

A SELECTED BIBLIOGRAPHY OF HIGHER ENVIRONMENTAL EDUCATION

Aldrich, James L., and Edward J. Kormondy, eds. *Environmental Education: Academia's Response* (Washington, D.C., 1972). This report on fifteen college and university programs is available from the American Institute of Biological Sciences, 3900 Wisconsin Ave., N.W., Washington, D.C. 20016.

Apostel, L., G. Berger, A. Briggs and G. Michaud, eds. *Interdisciplinarity: Problems of Teaching and Research in Universities* (Washington, D.C., 1972). This is a publication of the Organization for Economic Cooperation and Development.

Bunnell, Sterling. "Education for Human Survival" in Huey D. Johnson, ed., *No Deposit-No Return* (Reading, Massachusetts, 1970), 251-256.

Centre for Educational Research and Innovation, *Environmental Education at the University Level: Trends and Data* (Paris, 1973). The book reports the results of an international workshop held in Tours, France, April 4-8, 1971, and is distributed by the Organization for Economic Cooperation and Development, 2 Rue André-Pascal, 75775 Paris, Cedex 16, France.

Crowell, John. "Must Helpless Man Roll Darkling?: An Environmental Education Proposal," *International Journal of Environmental Studies*, 4 (1973), 207-212.

Crowell, John. "University Reorganization Through Environmental Studies," *Journal of Research and Development in Education*, 6 (1972), 110-114. Dr. Crowell is Co-chairman of Environmental Studies at the University of California/Santa Barbara and many of his ideas have found expression in this program.

De Bell, G. "Education and Ecology" in Garrett De Bell, ed., *The Environmental Handbook* (New York, 1970), 129-133.

Douglas, Lawrence M. "A College Program Based on Ecology" *Phi Delta Kappan*, 53 (1971), 160 ff.

"Education and the Environment" in *Institutions for Effective Management of the Environment* (Washington, D.C., 1970). This is a report of the Environmental Study Group of the National Academy of Sciences and the National Academy of Engineering.

Fischer, John. "Survival U: Prospectus for a Really Relevant University," *Harper's*, 239 (August 1969), 12 ff. Also in Garrett De Bell, ed., *The Environmental Handbook* (New York, 1970), 134-146.

Gold, Seymour M. "Environmental Studies: An Educational Prospectus," *International Journal of Environmental Studies*, 3 (1972), 55-64.

Hafner, Everett M. "The Challenge of Environmental Education," *BioScience*, 21 (1971), 535-536.

Hafner, Everett M. "Toward a New Discipline for the Seventies: Ecography" in John G. Mitchell and Constance L. Stallings, eds., *Ecotactics* (New York, 1970), 211-219.

Hall, R. H. "University Education and the Natural Environment: Are They Compatible?," *International Journal of Environmental Studies*, 2 (1970), 47-52.

Hare, F. K. "How Should We Treat the Environment?," *Science*, 167 (1970), 352-355.

Herrscher, Walter J. and Robert S. Cook. *Environmental Responsibility In Higher Education: Processes and Practices* (Green Bay, Wisconsin, 1973). A report of a national conference on environmental studies programs in higher education held at the University of Wisconsin/Green Bay, November 30-December 2, 1972. It is available from the office of Community Outreach, University of Wisconsin/Green Bay, Green Bay, Wisconsin 54302.

Hurd, P. D. "Education's Response to Awareness Needs" in Huey D. Johnson, ed., *No Deposit-No Return* (Reading, Mass., 1970), 250-251.

Jeffrey, David and Glenn Kagyama. "Innovating Relevant Curricula" in John G. Mitchell and Constance L. Stallings, eds., *Ecotactics* (New York, 1970), 220-228.

Kormondy, Edward J. "Environmental Education: The Whole Man Revisited," *American Biology Teacher*, 33 (1971), 15-17.

Kranzer, Herman C. "Conflicts in Conservation: Implications for the General Education of all College Students," *BioScience*, 18 (1968), 858-859.

Maslach, G. J. "The Reorganization of Educational Resources" in R. Revelle and H. H. Landsberg, eds., *America's Changing Environment* (Boston, 1970), 275-284.

McGowan, Alan. "Education: University Programs," *Environment*, 15 (1973), 5, 41-42.

Miles, Jack M. "Interdisciplinary Research Management in the University Environment." Presented at the annual meeting of the American Association for the Advancement of Science, January 1975.

Morrison, R. F. "Education for Environmental Concerns" in R. Revelle and H. H. Landsberg, eds., *America's Changing Environment* (Boston, 1970), 285-298.

Myrup, L. O. "Towards a Third Culture: Teaching Environmental Science" in Nigel Calder, ed., *Nature in the Round: A Guide To Environmental Science* (London, 1974).

Nash, Roderick. "Environmental Studies: The Santa Barbara Experience," (1973). A report on the undergraduate degree program at the University of California/Santa Barbara. It is available from Environmental Studies, University of California/Santa Barbara, Santa Barbara, California 93106.

Potter, V. R., et al. "Purpose and Function of the University," *Science*, 167 (1970), 1590-1593.

Schoenfeld, Clarence A. "Environmental Education and the University," *Educational Record*, 49 (1968), 305-310.

Schoenfeld, Clarence, ed. *Outlines of Environmental Education* (Madison, Wisconsin, 1971).

"Science Education in 'New' Colleges," *Science Education News* (April 1971).

Scriven, Michael. "Environmental Education" in Huey D. Johnson, ed., *No Deposit-No Return* (Reading, Massachusetts, 1970), 242-249.

Stapp, William B., ed. *Michigan's Environmental Future: A Master Plan for Environmental Education* (Lansing, Michigan, 1973). The Governor's Environmental Education Task Force submitted this report January 15, 1973; it is available from the Task Force, Executive Office of the Governor, Capitol Building, Lansing, Michigan 48903.

Stearns, Richard. "The Young Professional" in Huey D. Johnson, ed., *No Deposit-No Return* (Reading, Massachusetts, 1970), 257-259.

Steinhart, J. S. and S. Cherniak. *The Universities and Environmental Quality: The Commitment to Problem Focused Education* (Washington, D.C., 1969). This was a report prepared under the auspices of the Office of Science and Technology for the President's Environmental Quality Council. It is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Terry, Mark. *Teaching for Survival* (New York, 1971).

Toffler, Alvin. "Education in the Future Tense" in Alvin Toffler, *Future Shock* (New York, 1971), 353-378.

U.S. Department of Health, Education and Welfare, Office of Education. *A New Role for American Education* (Washington, D.C., 1970).

U.S. Department of Health, Education and Welfare, Office of Environmental Education. *Education That Cannot Wait* (Washington, D.C., 1971).

Weidner, E. W. "Educational Aspects of Environmental Issues," *International Journal of Environmental Studies*, 2 (1972), 301-308.

Weidner, E. W. "Interdisciplinary and Higher Education," *International Journal of Environmental Studies*, 5 (1973), 205-214.

Winn, Ira J. "The Environment of Reform," *Phi Delta Kappan*, 53 (1971), 157-159.